United States
Department of
Agriculture

Forest Service

**Forest Pest
Management**

Washington, DC

December 1994

Forest Insect and Disease Conditions in the United States 1993

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PREFACE

This is the 43rd annual report prepared by the U.S. Department of Agriculture, Forest Service, of the insect and disease conditions on the Nation's forests. This report responds to direction in the Cooperative Forestry Assistance Act of 1978, as amended, to conduct surveys and report annually on insect and disease conditions on all forests of the United States. Included in the report are the insect and disease conditions of major national significance in 1993. Insect and disease conditions of local importance are reported in Regional and State reports.

As in the past, selected insect and disease conditions are highlighted in the front section of the report. Some of these, for example gypsy moth, have been of concern for a long time. Others, such as the common European pine shoot beetle, are recent introductions.

The second section of the report is in a new format. Each insect and disease is discussed only once by bringing the information from each Region together under the organism's name. The organisms are arranged alphabetically in the appropriate section: insects–native; insects–nonnative; diseases–native; diseases–nonnative; diseases–origin unknown; declines and complexes; seed orchard insects and diseases; nursery insects and diseases; and abiotic damage. These categories are listed in the table of contents; there is no index.

The information in this report is provided by the Forest Pest Management Program of the Forest Service. This program serves all Federal lands including the national forests and the lands administered by the Departments of Defense and the Interior. The program also provides assistance to private landowners through the State Foresters. A key part of the program is the detecting and reporting of insect and disease epidemics, and effects of wind, air pollution, and other agents. Detection surveys are conducted on a regular basis by Forest Service and State program specialists.

For additional information about conditions, contact the Forest Service Regional Office listed below (see map for office coverage) or the State Forester.

Forest Service, USDA
Northern Region (R-1)
P.O. Box 7669
Missoula, MT 59807
(406) 329-3605

Forest Service, USDA
Rocky Mountain Region (R-2)
P.O. Box 25127
Denver, CO 80225
(303) 275-5074

Forest Service, USDA
Southwestern Region (R-3)
517 Gold Avenue, S.W.
Albuquerque, NM 87102
(505) 842-3281

Forest Service, USDA
Intermountain Region (R-4)
324 25th Street
Ogden, UT 84401
(801) 625-5257

Forest Service, USDA
Pacific Southwest Region (R-5)
630 Sansome Street
San Francisco, CA 94111
(415) 705-2660

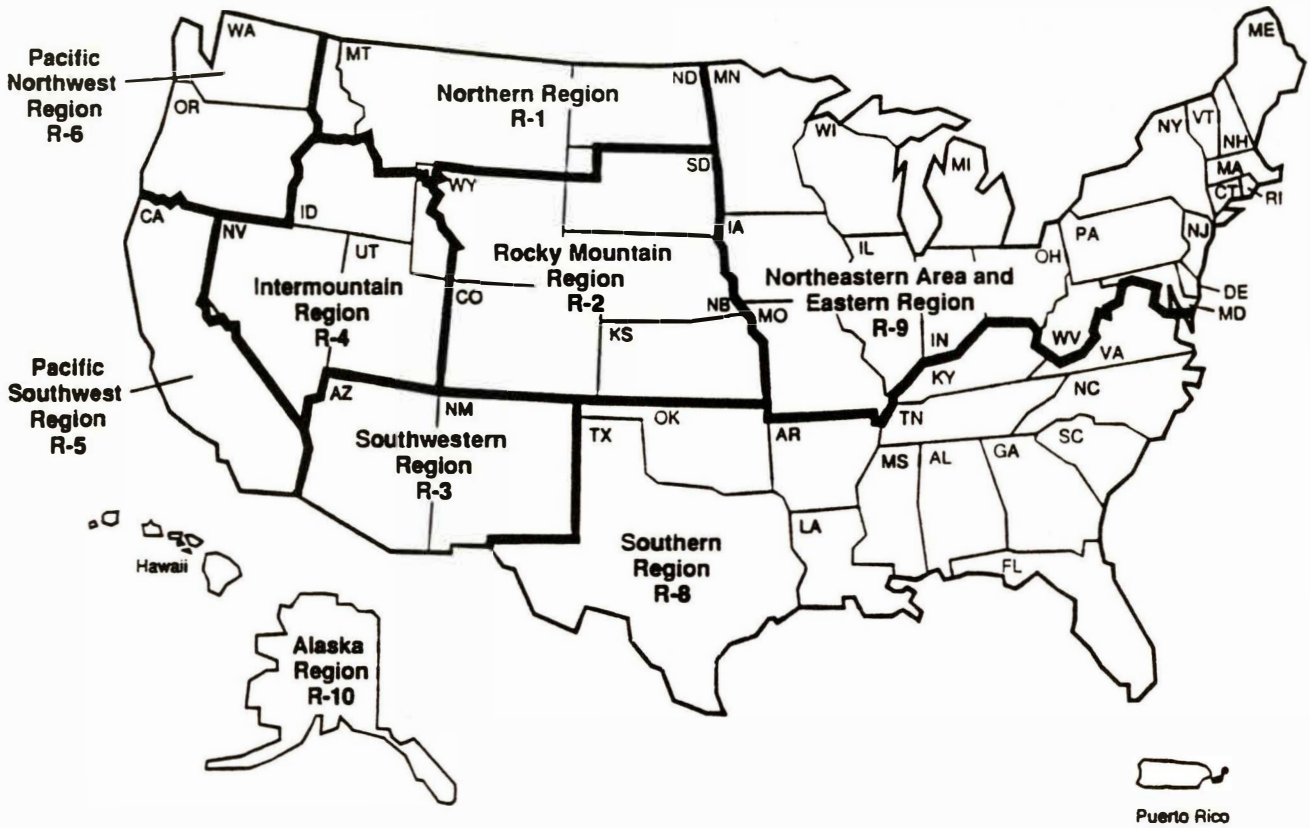
Forest Service, USDA
Pacific Northwest Region (R-6)
P.O. Box 3623
Portland, OR 97208
(503) 326-6666

Forest Service, USDA
Southern Region (R-8)
1720 Peachtree Road, N.W., Room 925N
Atlanta, GA 30367
(404) 347-2961

Forest Service, USDA
Northeastern Area
5 Radnor Corporate Center Suite 200
P.O. Box 6775
Radnor, PA 19087-8775
(610) 975-4124

Forest Service, USDA
Alaska Region (R-10)
3301 "C" Street, Suite 522
Anchorage, AK 99503
(907) 271-2575

USDA Forest Service Regions and Area



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Forest Service, USDA
Forest Pest Management
P.O. Box 96090
Washington, DC 20090-6090

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EXECUTIVE SUMMARY

About one-third of the Nation's land area, over 730 million acres, is forested. These forests provide economic, social and environmental benefits. Native and introduced nonnative insects and diseases as well as abiotic influences all effect the health and productivity of the forests.

Highlighted below are some of the major native insects and diseases of concern. Also highlighted are some nonnative insects and diseases that have been introduced into the United States. These pests either are causing serious damage or have the potential to do so.

Insects: native

Southern pine beetle–affected acreage declined by 27 percent to 10 million acres. Virginia is experiencing the worst outbreak in the history of the State.

Mountain pine beetle–affected acreage has steadily declined since the early 1980's. Outbreaks exist on about 782,000 acres.

Spruce budworm–populations remain low following the decline in 1986. The only significant outbreak is in Minnesota.

Western spruce budworm–defoliation westwide is less than 1 million acres for the first time in several years.

Spruce beetle–acreage of tree mortality in Alaska has reached over 700,000 acres. Five consecutive years of exceptionally warm spring and summer weather has aided the outbreak.

Insects: nonnative

Gypsy moth-European–over 1.8 million acres of eastern forests in the generally infested area were defoliated in 1993. Eradication projects were conducted in eight states.

Gypsy moth-Asian–found in the Wilmington, North Carolina, area in 1993. An eradication project is planned for 1994. This variety feeds on an even greater variety of host species than the European variety.

Common European pine shoot beetle–discovered in 1992 in Ohio and is now found in six states; Illinois, Indiana, Michigan, New York, Ohio, and Pennsylvania. State and Federal quarantines are in force.

Hemlock woolly adelgid–introduced into Virginia in 1950; it has become a serious threat to eastern hemlock. The adelgid was reported on the West Coast in 1920, but is doing little damage.

Diseases: native

Fusiform rust–is the most damaging disease of pines in the South. An estimated 13.7 million acres of pines are affected.

Dwarf mistletoes–a perennial problem in the West reducing tree growth and killing trees on more than 28.8 million acres.

Diseases: nonnative

White pine blister rust–introduced about the turn of the century and now occurs throughout most of the ranges of the five-needle pines including eastern white pine, western white pine, and sugar pine. The disease continues to cause significant tree mortality. It continues to spread to new areas. In 1990, it was found in New Mexico and is threatening viability of southwestern white pine.

Beech bark disease–is the result of an attack by the beech scale followed by invasion of a fungus. The scale was introduced into North America about 1890. The disease is found killing beech trees from Maine to Pennsylvania with outlying spots in West Virginia, North Carolina, and Tennessee.

Diseases: origin unknown

Dogwood anthracnose–first found in 1970's, it is now found in 19 eastern states. The disease kills woodland and ornamental dogwoods.

Butternut canker–found throughout most of the range of butternut and is a threat to the survival of the tree species.

Abiotic damage

Wind, drought, ice, and other abiotic factors damage forests. Often these factors predispose the trees to insect and disease buildups.

The second part of the report provides more information about the above insects, diseases, and abiotic factors, and a number of other damaging agents.

Part 1 National Highlights

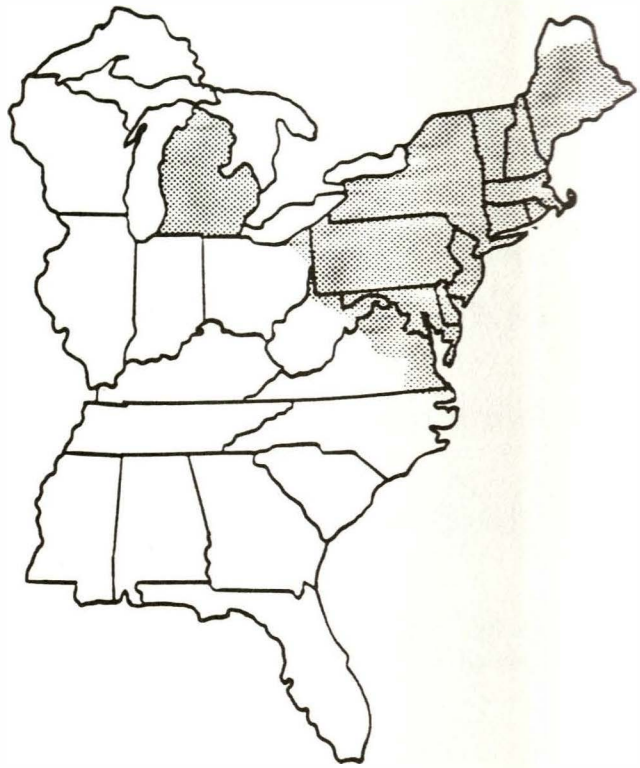
Insect Conditions Highlights

Gypsy moth (European form) (*Lymantria dispar*) was introduced into Massachusetts in 1869, and continues to spread south and west. Over 1.8 million acres of hardwood forests were defoliated in 1993 with almost 112 million cubic feet of wood killed. These figures would be higher except for the suppression projects conducted on the highest-valued lands.

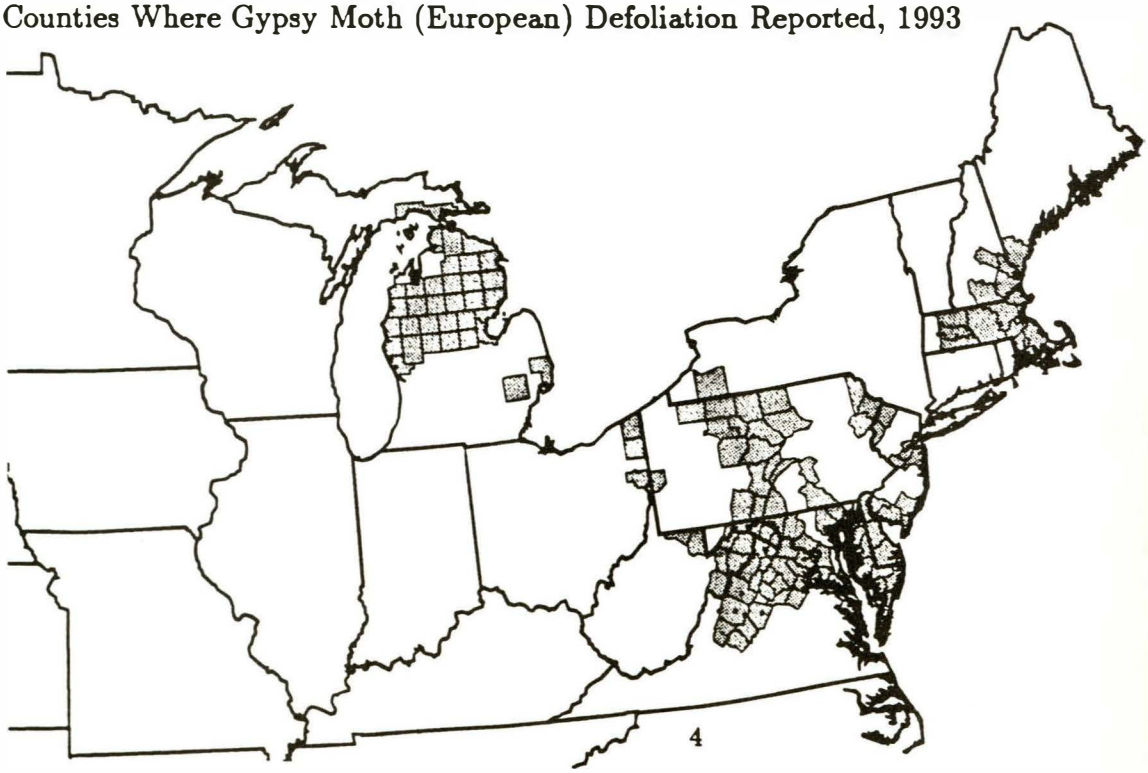
Eradication projects were conducted on outlying infestations of European gypsy moths in Arkansas, Georgia, North Carolina, Tennessee, Virginia, Utah, West Virginia, and Wisconsin. These projects were conducted by cooperating State and local agencies and the Forest Service.

The Asian form of the gypsy moth was found in Oregon and Washington in 1991 and eradicated in 1992. These moths came from grain ships arriving from Siberian ports. In 1993, an infestation was found in the Wilmington, North Carolina, vicinity, arriving on ships returning U.S. military equipment from Germany. An eradication project is planned for 1994. The Asian gypsy moth is thought to be more damaging as it feeds on a greater variety of host species and the females can fly; European gypsy moth females do not fly.

Gypsy Moth (European) Generally Infested Area (Shaded), 1993



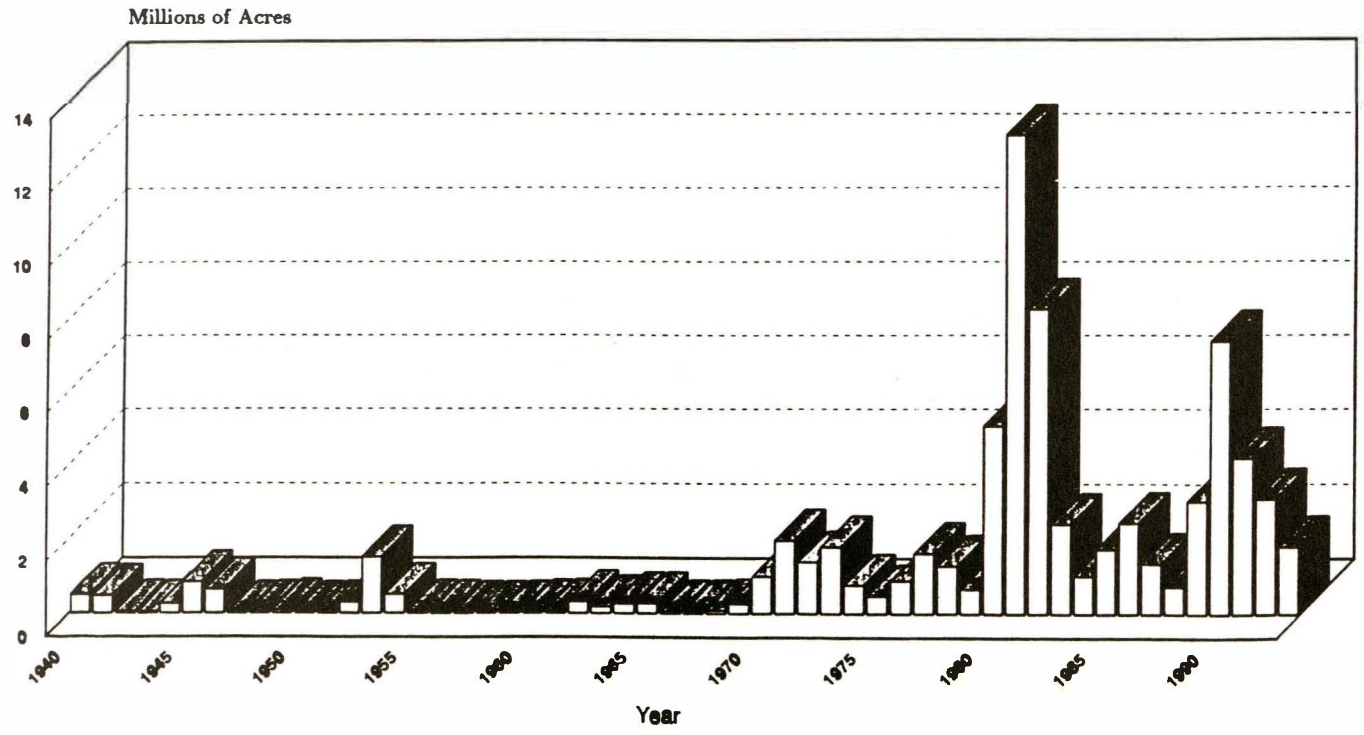
Counties Where Gypsy Moth (European) Defoliation Reported, 1993



Acres of Aerially-Detected Gypsy Moth (European) Defoliation, 1989-1993

State	1989	1990	1991	1992	1993
Connecticut	78,430	176,576	50,154	31,637	0
Delaware	1,888	3,790	13,475	4,943	26,700
Maine	35,000	270,433	614,509	278,485	50,700
Maryland	97,911	133,062	75,197	38,704	68,900
Massachusetts	950	83,595	282,143	123,794	88,700
Michigan	294,344	358,338	626,689	712,227	399,300
New Hampshire	18,395	133,200	180,870	182,575	10,100
New Jersey	137,310	431,235	169,900	165,960	27,700
New York	421,138	354,162	175,960	60,022	2,000
Ohio	0	115	345	1,130	600
Pennsylvania	1,506,790	4,357,700	1,230,066	641,445	318,100
Rhode Island	0	0	0	0	0
Vermont	27,335	63,000	3,596	83	0
Virginia	289,332	594,000	616,200	748,000	589,100
Washington, DC	0	10	125	0	0
West Virginia	86,736	345,078	112,900	67,508	202,500
Total	2,995,559	7,304,294	4,152,129	3,056,513	1,784,400

Gypsy Moth (European) Defoliation, 1940-1993



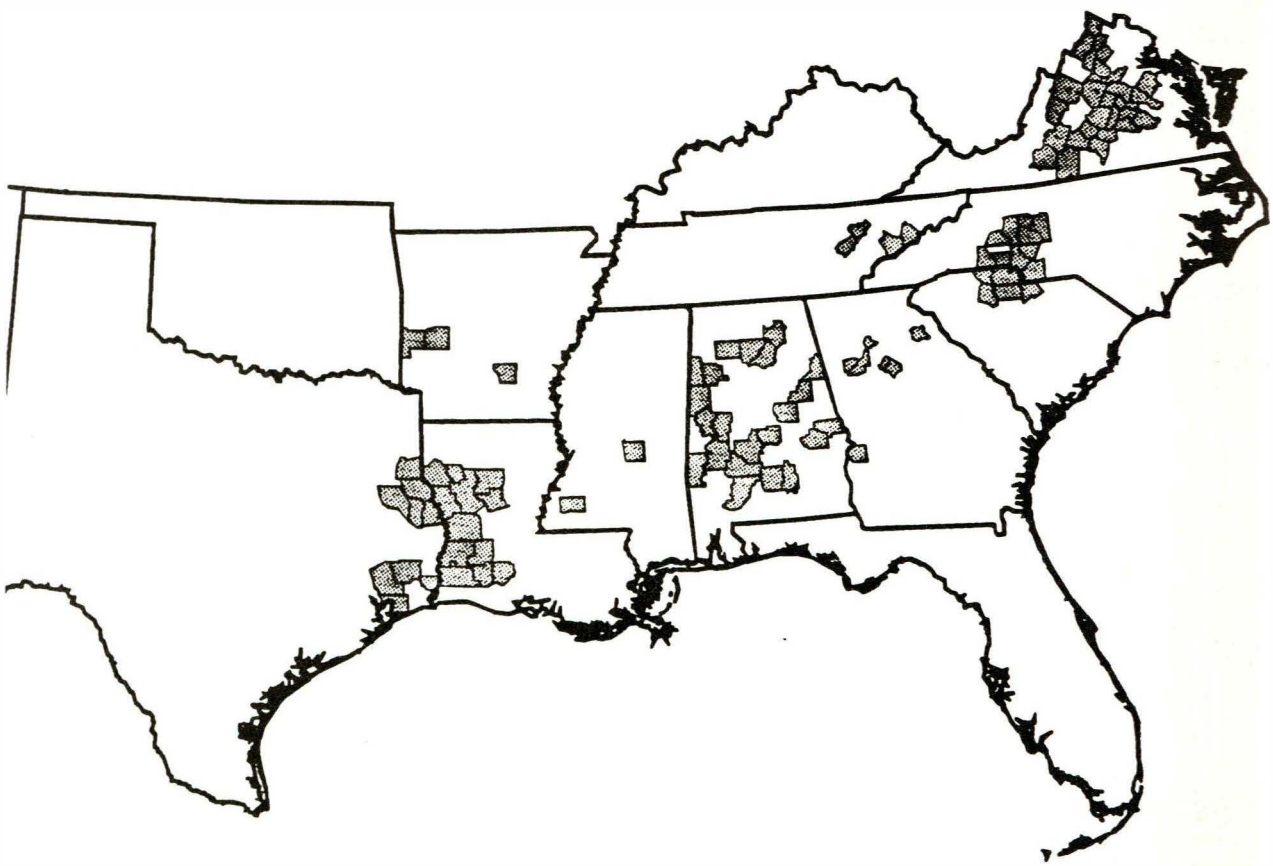
Southern pine beetle (*Dendroctonus frontalis*)-affected acreage in the South declined by 27 percent from 1992 (14 million acres to 10 million acres even though the number of infestations increased). The number of counties classified as "outbreak counties" decreased from 131 in 1992 to 103 in 1993. Outbreak counties are defined as counties with one or more multiple-tree infestations per 1,000 acres of host type.

Declines in affected acreage occurred in the southernmost tier of States from South Carolina to Texas. Southern pine beetle populations in the wildernesses on the National Forests in Texas continued to cause significant tree mortality, threatening or in some cases moving onto adjacent land.

The acreage affected by the southern pine beetle increased in North Carolina, Tennessee, and Arkansas. In Virginia, the number of affected acres increased to over 1.5 million acres. Virginia recorded the highest number of infestations in the State's history. The number of outbreak counties in Virginia increased from 13 to 30.

Further north, Delaware and West Virginia reported activity for the first time in recent years. In Maryland, 15 affected acres detected in 1991 increased to 2,000 scattered acres in 1993.

Counties Where Southern Pine Beetle Outbreaks Reported In Southern Region (R-8), 1993

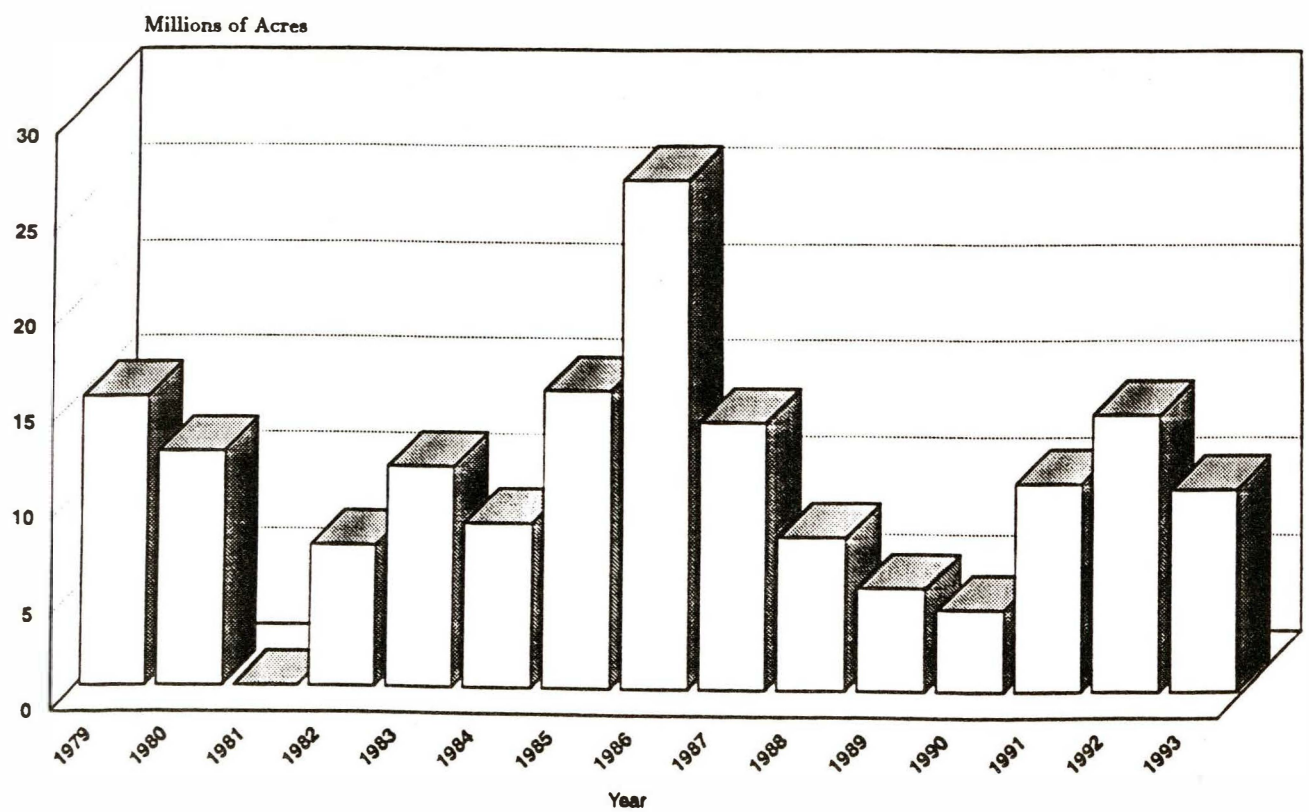


Acres of Southern Pine Beetle Outbreaks In Southern Region (R-8), 1989-1993*

State	1989	1990	1991	1992	1993
			Thousand acres		
Alabama	724.0	0.0	3,937.1	5,815.7	2,753.4
Arkansas	0.0	0.0	0.0	55.8	649.1
Georgia	850.0	0.0	346.5	871.0	587.3
Florida	0.0	0.0	0.0	0.0	0.0
Kentucky	0.0	0.0	0.0	0.0	0.0
Louisiana	17.0	0.0	1,197.6	3,112.4	2,291.9
Mississippi	319.0	0.0	1,278.4	406.1	331.5
North Carolina	342.0	111.4	40.1	334.3	569.6
Oklahoma	0.0	0.0	0.0	0.0	0.0
South Carolina	753.0	2,320.7	2,413.6	469.2	366.4
Tennessee	427.0	0.0	0.0	45.9	173.0
Texas	1,901.0	1,800.0	1,495.9	2,663.3	1,106.8
Virginia	0.0	0.0	35.0	533.6	1,584.6
Total	5,333.0	4,232.1	10,744.2	14,307.3	10,413.6

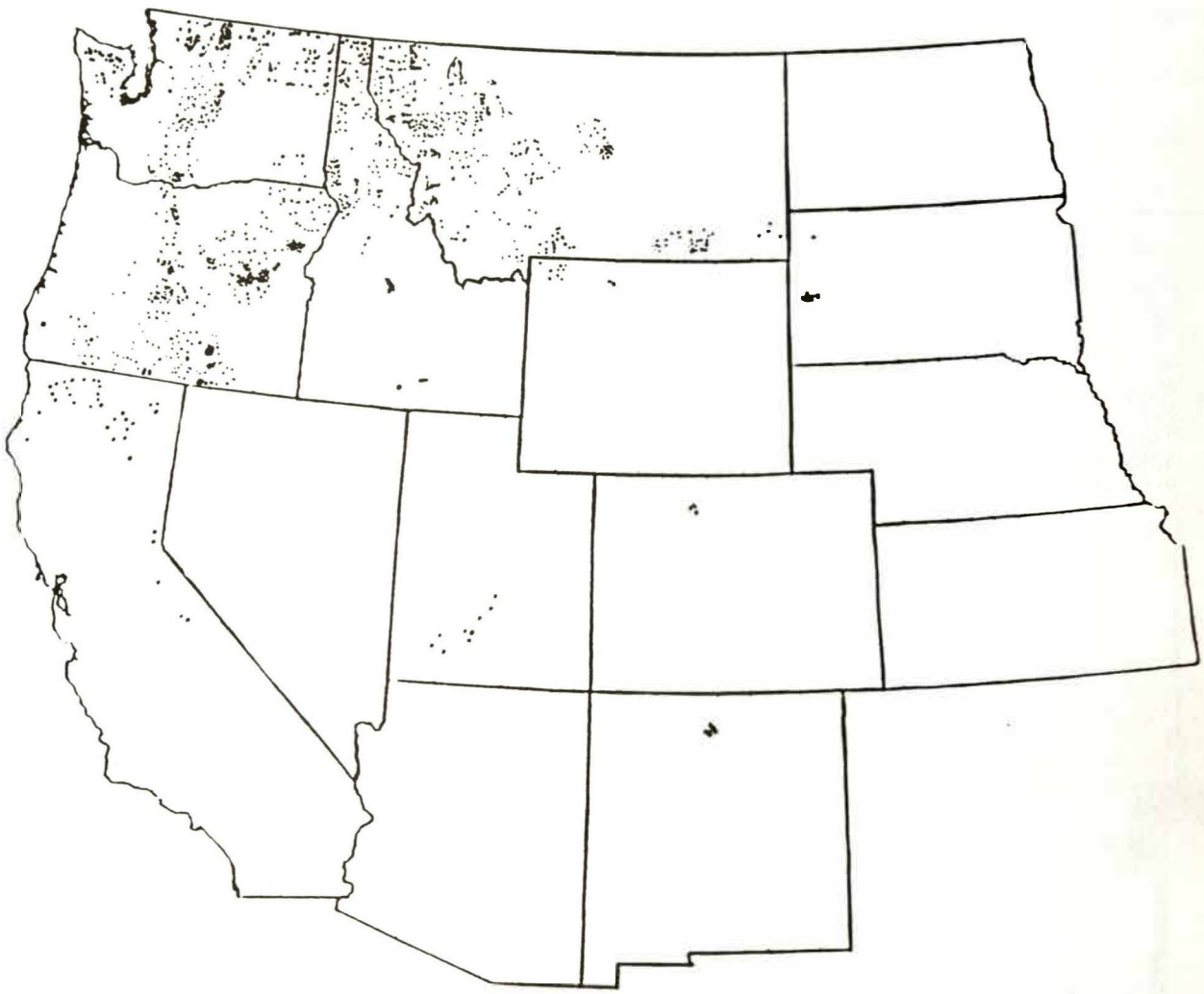
*Acres of outbreak are acres of host type having one or more multi-tree spots per 1,000 acres.

Southern Pine Beetle Infestations In Southern Region (R-8), 1979-1993.



Mountain pine beetle (*Dendroctonus ponderosae*)-affected acreage has steadily declined since the high years of the early 1980's. Still, about 1.5 million trees were killed on about three-quarters of a million acres in 1993. About 54 percent of the mountain pine beetle-killed trees are in Oregon and Washington. The beetle-infested acreage in Montana and northern Idaho is the lowest in two decades, however, the number of beetle-killed trees in southern Idaho increased significantly. Tree mortality caused by the beetle decreased by 83 percent in the Black Hills of South Dakota. Very small scattered infestations are neither mapped nor acreages reported.

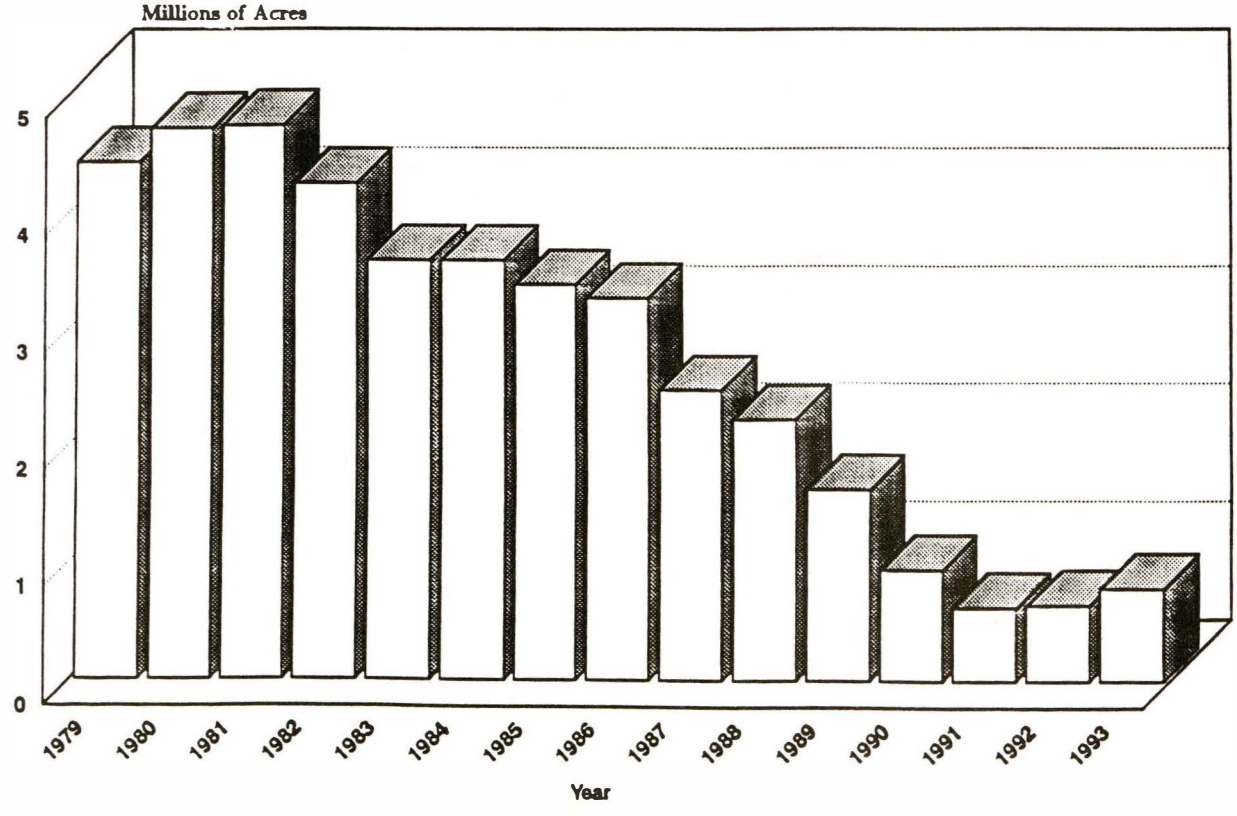
Mountain Pine Beetle Outbreak Areas, 1993



Acres of Mountain Pine Beetle Outbreak, 1989-1993

State	1989	1990	1991	1992	1993
			Thousand acres		
Arizona	0.9	0.6	0.0	0.0	0.0
California	—	—	—	—	121.0
Colorado	12.0	9.8	1.5	0.0	0.0
Idaho	41.6	15.2	22.5	22.4	43.7
Montana	421.5	195.2	160.0	65.9	43.4
New Mexico	1.0	0.8	1.4	1.2	1.4
Oregon	887.9	245.1	249.6	303.0	345.6
South Dakota	2.4	6.8	10.0	13,6	13.6
Utah	4.5	2.0	1.3	4.1	10.0
Washington	231.4	431.7	155.4	125.2	200.3
Wyoming	11.4	28.3	15.4	106.0	2.8
Total	1,614.6	9,35.5	617.1	641.4	781.8

Mountain Pine Beetle Infestations, 1979-1993.



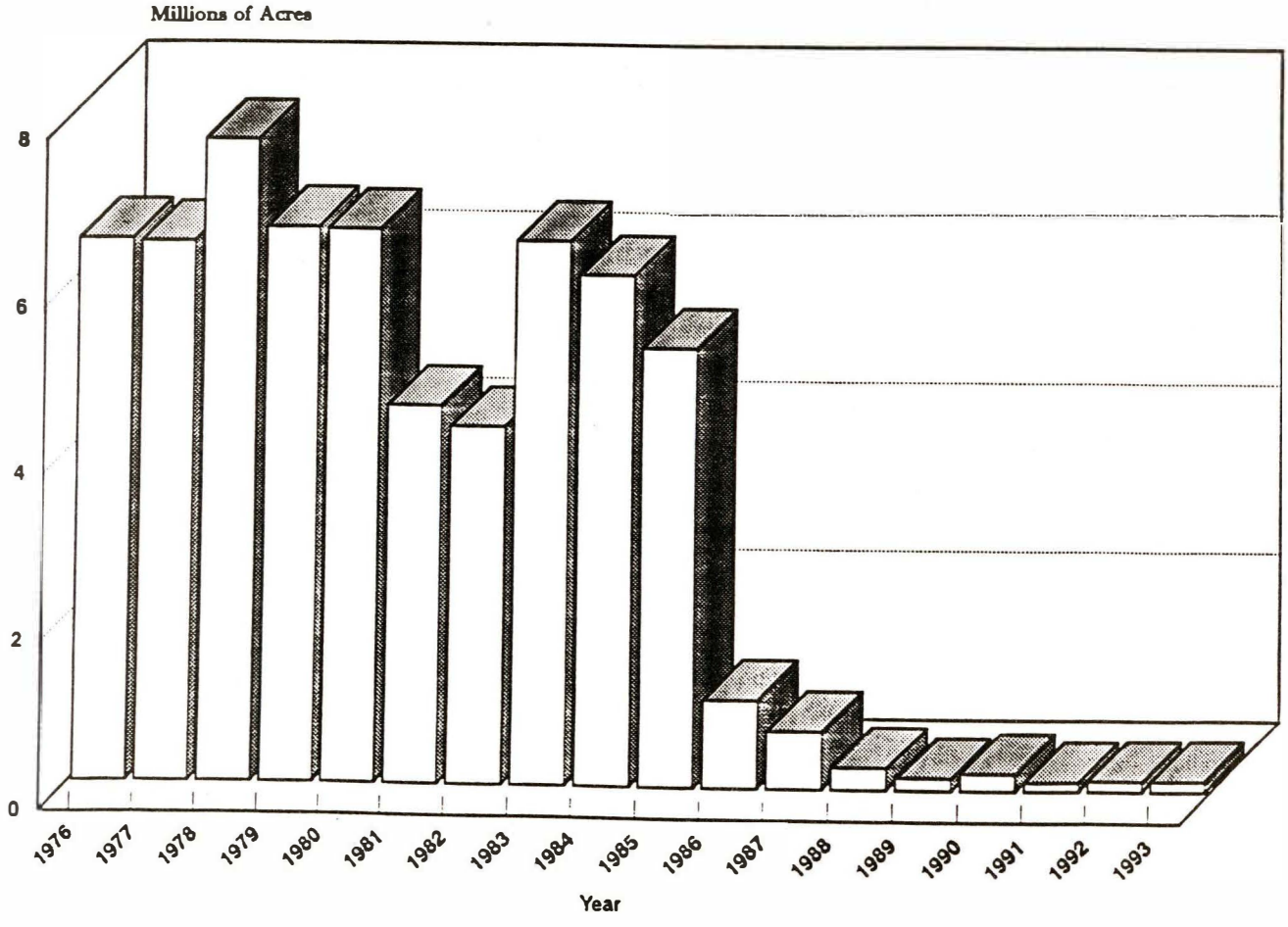
Spruce budworm (*Choristoneura fumiferana*) is a native insect found in northern New England, New York, and the Lake States. The acreage defoliated in 1993 remains low following the huge outbreaks of the late 1970's and early 1980's.

Counties Where Spruce Budworm Defoliation Reported, 1993

Acres of Aerially-Detected Spruce Budworm Defoliation, 1989-1993

State	1989	1990	1991	1992	1993
			Thousand acres		
Maine	4.8	0.0	0.0	0.0	0.0
Michigan	0.0	2.5	0.0	0.0	0.0
Minnesota	140.0	198.0	108.0	126.0	116.0
New Hampshire	0.0	0.0	0.0	0.0	0.0
New York	0.0	0.0	0.0	0.0	0.0
Vermont	0.0	0.0	0.0	0 0	0.0
Wisconsin	0.0	0.0	0.0	0.0	0.0
Total	144.8	200.5	108.0	126.0	116.0

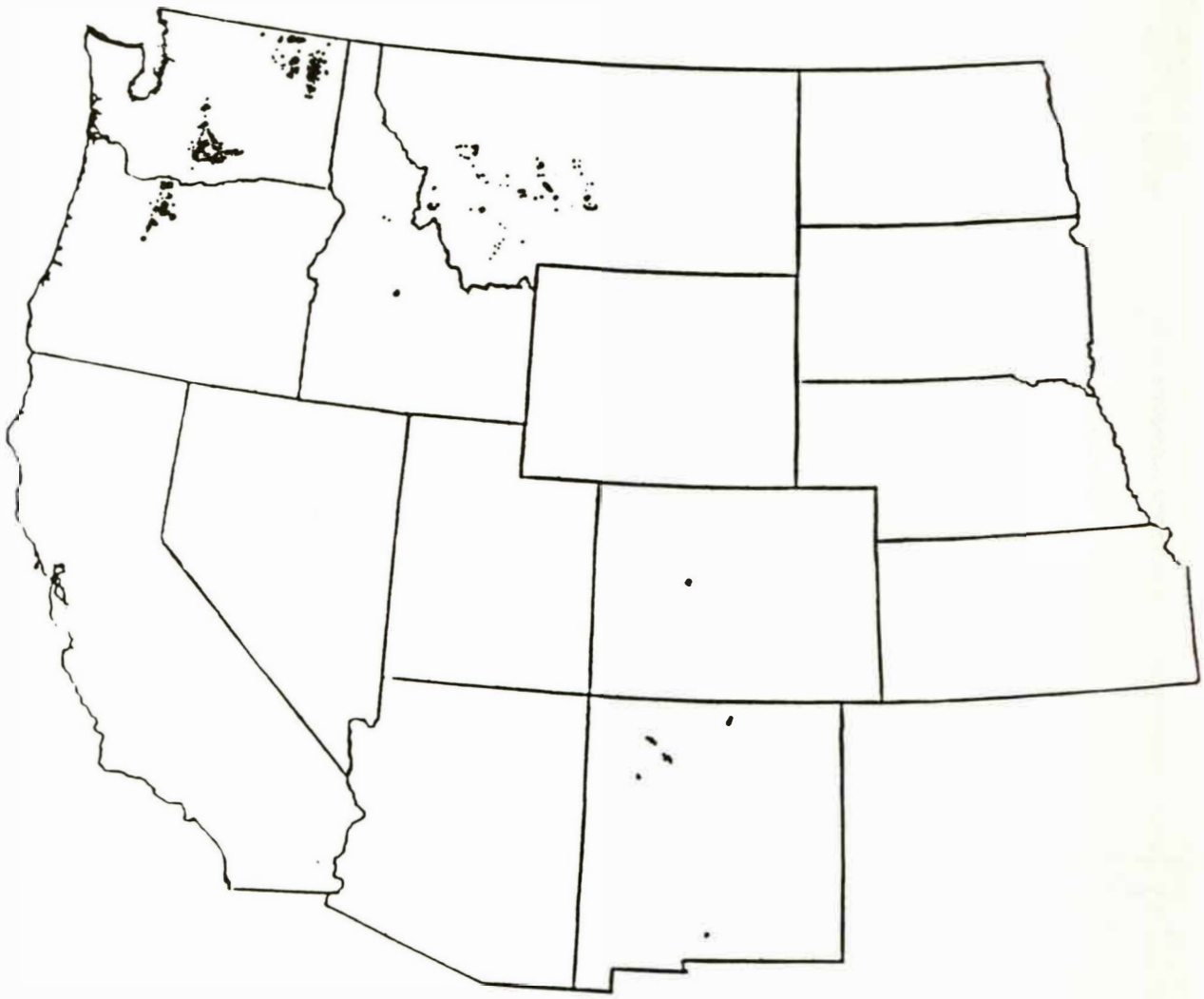
Spruce Budworm Defoliation, 1976-1993.



Western spruce budworm (*Choristoneura occidentalis*) defoliation decreased to less than 1 million acres westwide for the first time in several years. Defoliation in Montana and northern Idaho declined by 95 percent between 1992 and 1993 and is at the lowest level since 1948.

Defoliation in Oregon and Washington declined significantly to the lowest level in at least the last 5 years. No defoliation was detected in the Blue Mountains of eastern Oregon and Washington. Even with this major decline, almost 75 percent of the defoliation westwide occurred in these two states; 71 percent of the much larger defoliation in 1992 also occurred in these states. Small scattered acreages are not mapped.

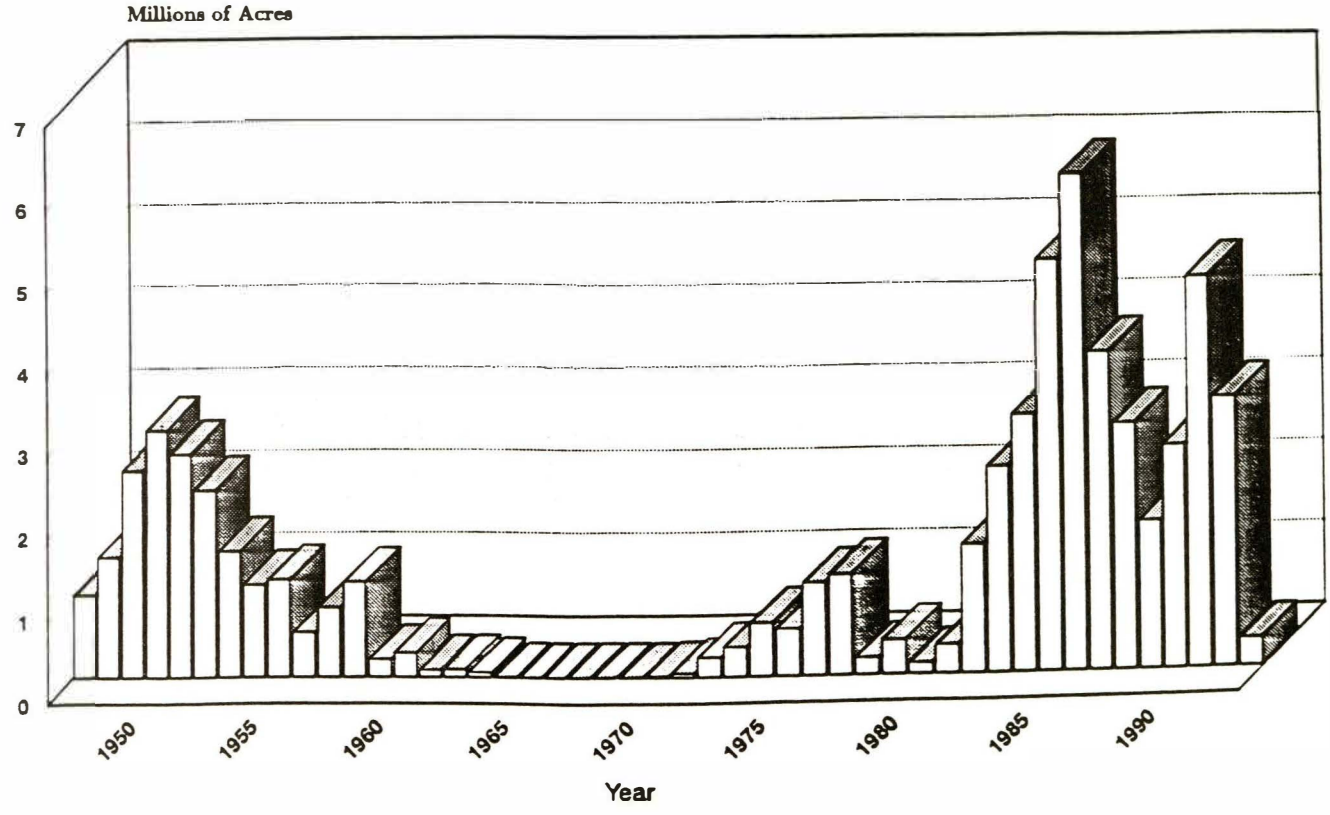
Western Spruce Budworm Defoliaton Areas, 1993



Acres of Aerially-Detected Western Spruce Budworm Defoliation, 1989-1993

State	1989	1990	1991	1992	1993
			Thousand acres		
Arizona	0.7	25.6	0.0	11.5	0.0
California	0.0	0.0	0.0	0.0	0.0
Colorado	52.0	52.1	509.0	272.2	1.2
Idaho	26.6	48.0	61.5	89.8	0.9
Montana	1,191.3	1,492.4	1,595.7	941.3	44.2
New Mexico	90.1	310.5	218.6	9.4	66.4
Oregon	1,416.7	2,344.3	3,724.9	1,937.7	87.7
Utah	0.0	0.0	0.0	0.0	0.0
Washington	362.3	351.0	1,027.7	1,329.5	243.8
Wyoming	0.0	8.1	33.5	2.5	2.5
Total	3,139.7	4,632.0	7,170.9	4,593.9	446.7

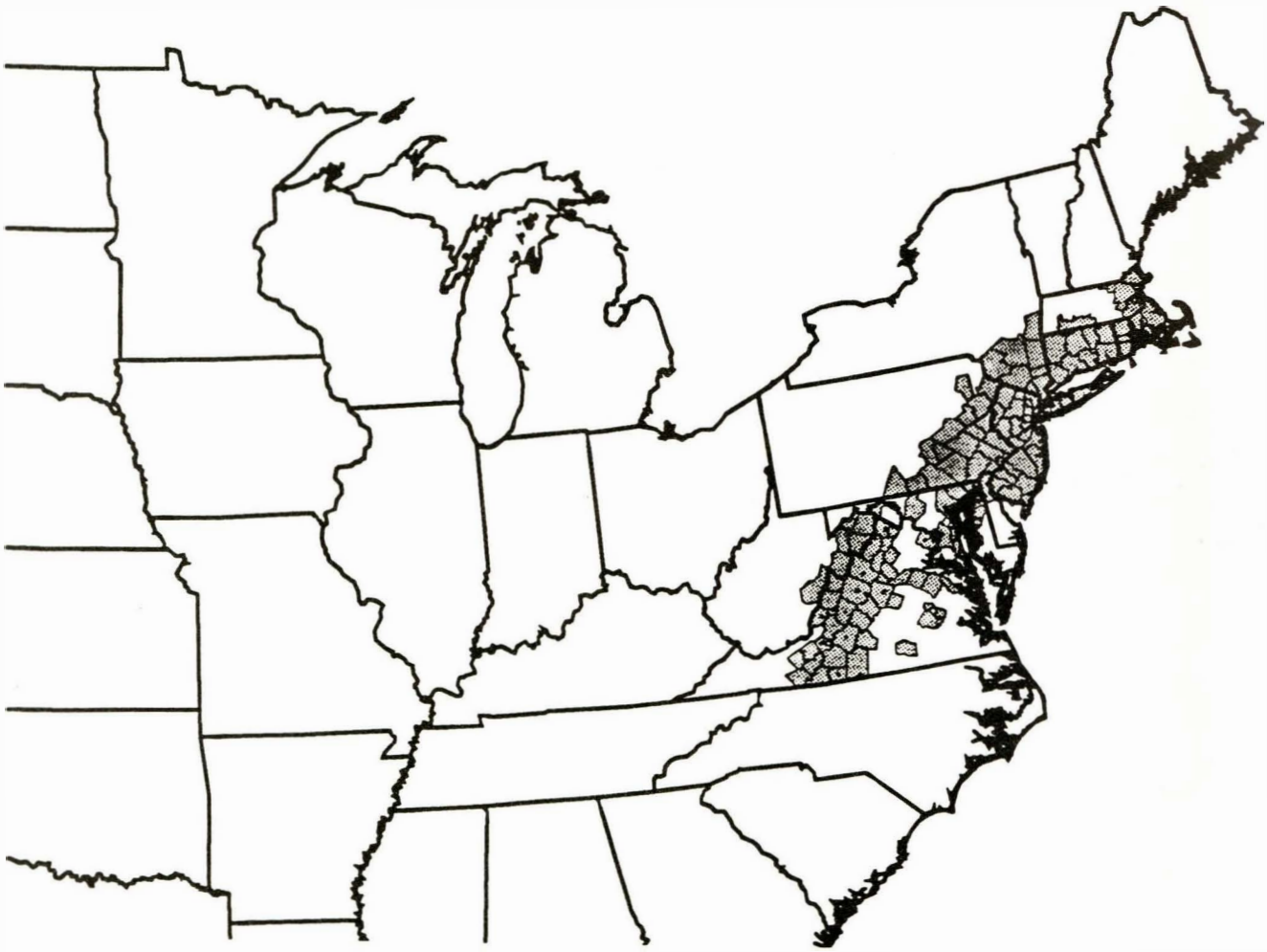
Western Spruce Budworm Defoliation in Pacific Northwest Region (R-6), 1947-1993.



Hemlock woolly adelgid (*Adelges tsugae*) was reported on the West Coast in 1920. It does very little damage in the forest but sometimes kills ornamental trees.

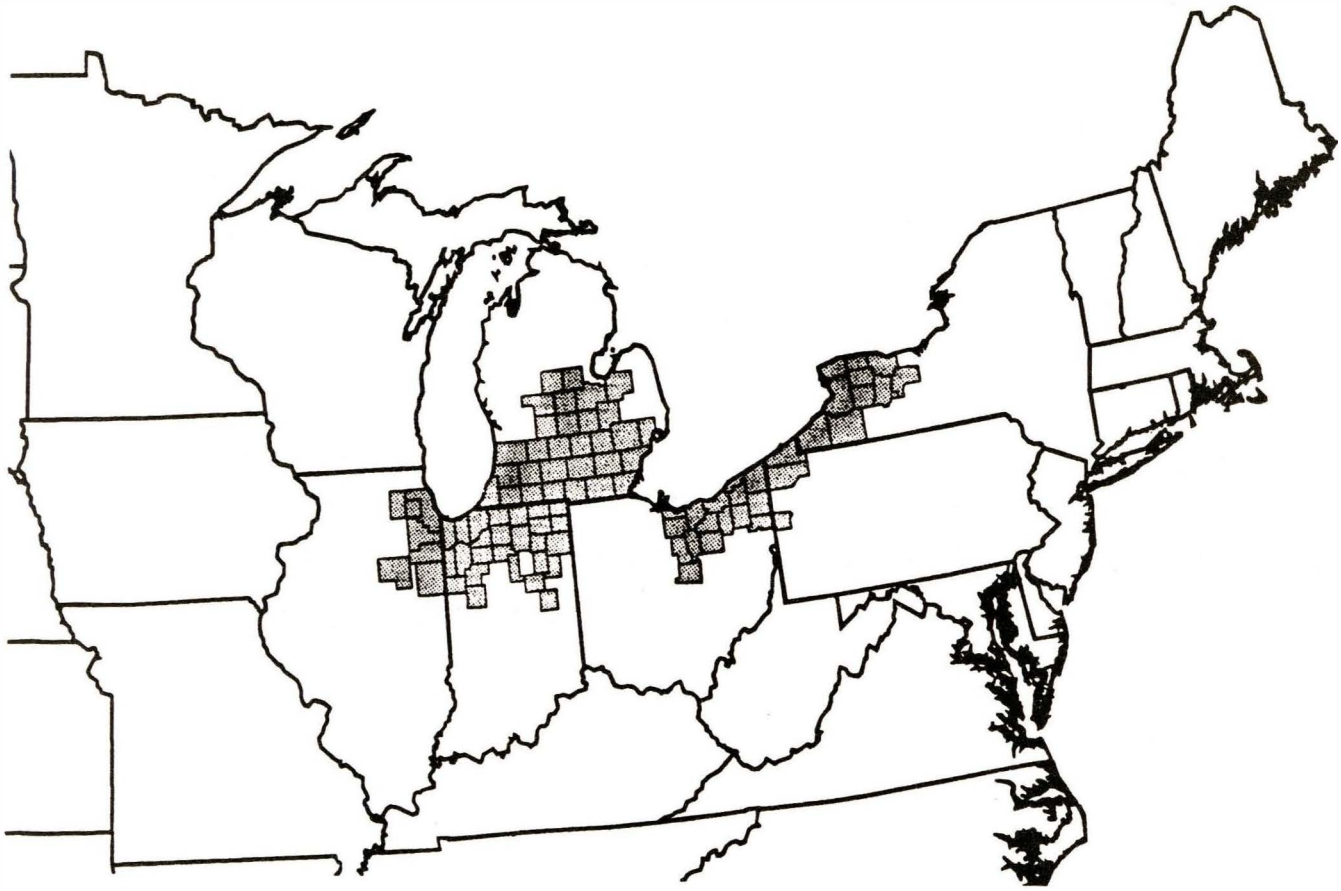
In 1950 the insect was introduced into Virginia and has spread north into southern New England. In Virginia, it is found as far south as the counties bordering North Carolina and Tennessee. It has not been found across the border. The adelgid has caused mortality of eastern hemlock in some areas.

Counties Where Hemlock Woolly Adelgid Reported, 1993



Common European pine shoot beetle (*Tomicus piniperda*) was discovered near Cleveland, Ohio, in 1992. It is now found in 6 States. Infested counties have been placed under State and Federal quarantine to prevent movement of the beetle to new areas. The beetle prefers Scotch pine but feeds on other pines as well. Thus far, it is a problem mainly for Christmas tree growers.

Counties Were Common European Pine Shoot Beetle Reported, 1993

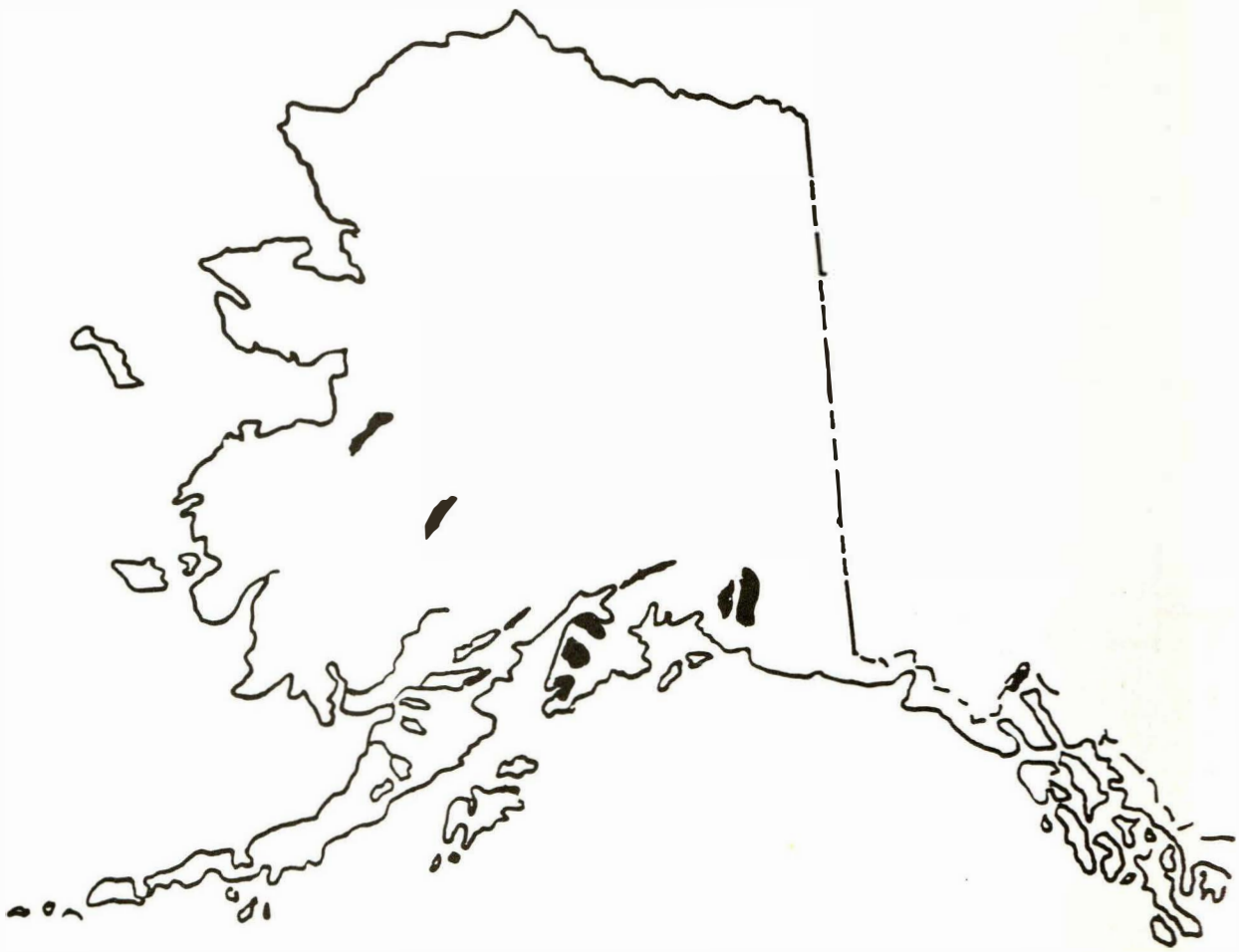


Spruce beetle (*Dendroctonus rufipennis*) is a native insect that occurs across northern North America and south in the Rocky Mountains to Arizona. In Alaska, the affected acreage has increased from 177,000 acres in 1989 to over 700,000 acres in 1993. In 1993, an estimated 68 million trees were killed. A series of exceptionally warm springs and summers have provided impetus to the outbreak. The infestation is expected to continue to expand in 1994. The outbreak is largely on State and private lands.

No significant beetle activity was reported from California, Oregon, and Washington. Scattered activity occurred on about 48,400 acres in Montana, Idaho, Utah, Arizona, and New Mexico. In Montana, an outbreak developed in fire-weaken trees in the Gallatin National Forest and Yellowstone National Park.

In the East, some beetle activity was reported from a coastal area in Maine, and spruce mortality was reported in New York.

Spruce Beetle Areas In Alaska, 1993



Disease Conditions Highlights

Root diseases, especially annosus root disease (*Heterobasidion annosum*) and armillaria root disease (*Armillaria* spp.), are among the most serious pests in the West. Mortality is particularly severe in drought-stricken stands where root diseases and bark beetles work together. Damage has increased greatly over the century because of altered forest conditions and structure due to fire control and past management practices.

In the South, annosus root disease is significant in pine plantations, especially those where tree thinning has occurred. Bark beetle infestations often occur in diseased stands. Root-diseased trees become hazardous in recreation areas and along roadsides.

White pine blister rust (*Cronartium ribicola*) is an introduced disease first found in New York State in 1906. The disease has spread throughout the range of eastern white pine. The disease was found for the first time in western North America in 1921 in British Columbia. It has spread throughout much of the West affecting western white pine and to some extent sugar pine causing significant tree mortality. In 1990, the disease was found affecting southwestern white pine in New Mexico; in 1993, about one-half million acres are affected.

Fusiform rust (*Cronartium quercuum* f. sp. *fusiforme*), a native disease, continues to be the most damaging disease of loblolly and slash pines in the South. An estimated 13.7 million acres of pines are affected. Acres are classified as affected if more than 10 percent of the trees have potentially lethal cankers. Georgia is the most seriously affected State with 4.6 million acres, 49 percent of host type affected. A revised method used in 1993 for analyzing infection data from previous years' surveys precludes making comparisons to previous conditions reports.

Acres Affected by Fusiform Rust, 1993*

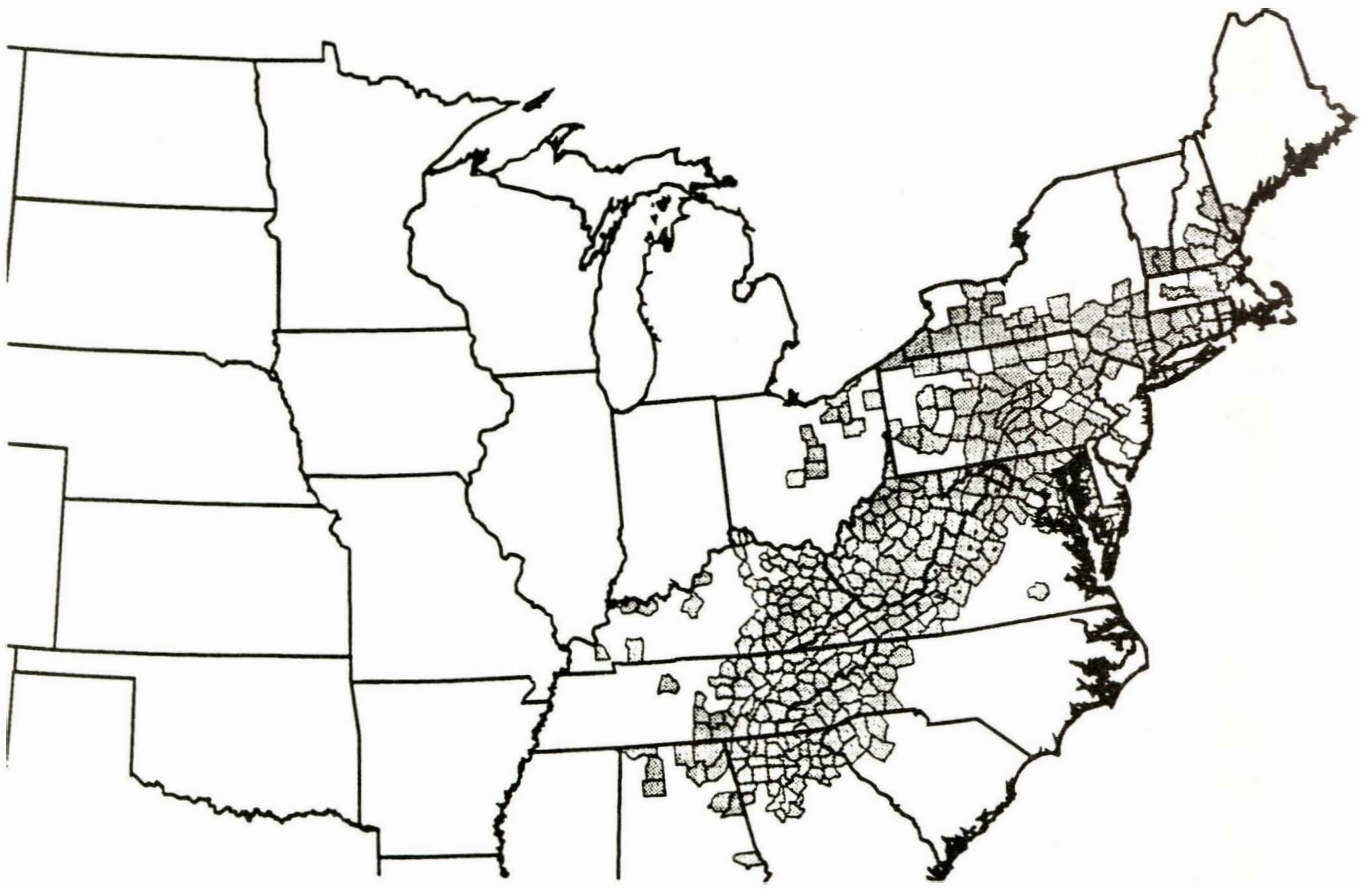
State (survey year)	National Forest	Other Federal	State and Private	Total
		Thousand acres		
Alabama (90)	7.1	0.0	1,704.2	1,711.3
Arkansas (88)	0.0	0.0	166.9	166.9
Florida (87)	20.8	9.8	1,135.9	1,166.5
Georgia (89)	38.0	102.8	4,452.9	4,593.7
Louisiana (91)	85.0	18.4	1,554.9	1,658.3
Mississippi (87)	121.2	0.0	1,147.9	1,268.4
North Carolina (90)	4.9	7.8	956.2	968.9
Oklahoma (92)	0.0	0.0	33.9	33.9
South Carolina (86)	63.8	52.3	1,539.4	1,655.5
Texas (92)	21.8	0.0	397.3	419.1
Virginia (92)	0.0	0.0	59.3	59.3
Total	362.6	191.1	13,148.1	13,701.8

*Acres with greater than 10 percent infection.

Dogwood anthracnose (*Discula destructiva*) is caused by a fungus of unknown origin. The fungus may have been introduced or a previously innocuous fungus may have become a significant pathogen. The disease was first discovered in the Northeast in the 1970's. By 1987, it was found in 9 States from Massachusetts to Georgia, and by 1993 it was confirmed in 19 States from Maine to Georgia and west in Ohio, Kentucky, Tennessee, and Alabama. The disease affects both woodland and ornamental dogwoods. Damage is most severe at higher elevations and in cool, moist areas in lower elevations.

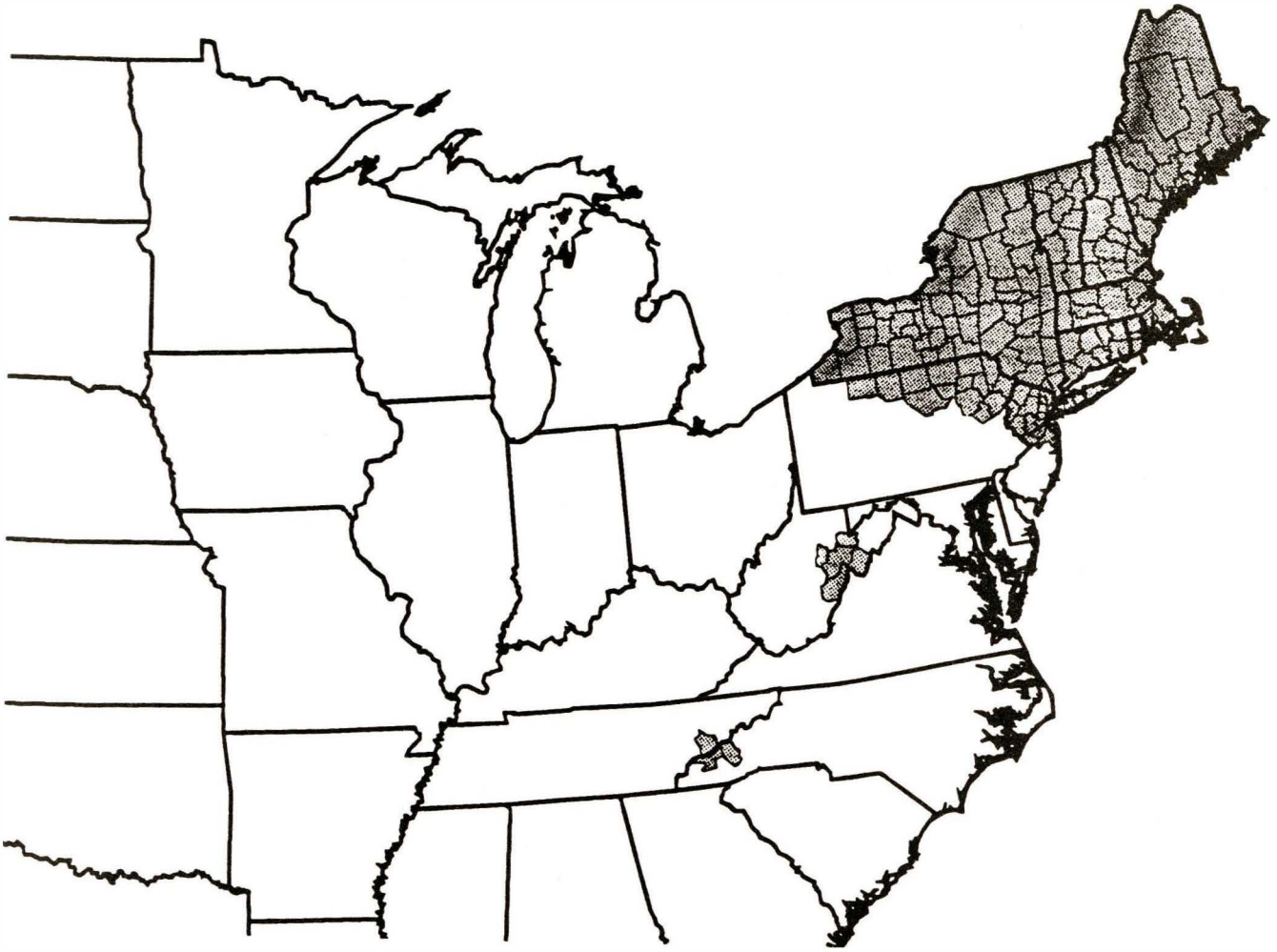
Dogwood anthracnose was found in Washington in 1979 and by 1983 the disease was found in Oregon and Idaho. The disease is not as severe as in the East.

Eastern Counties Where Dogwood Anthracnose Reported, 1993



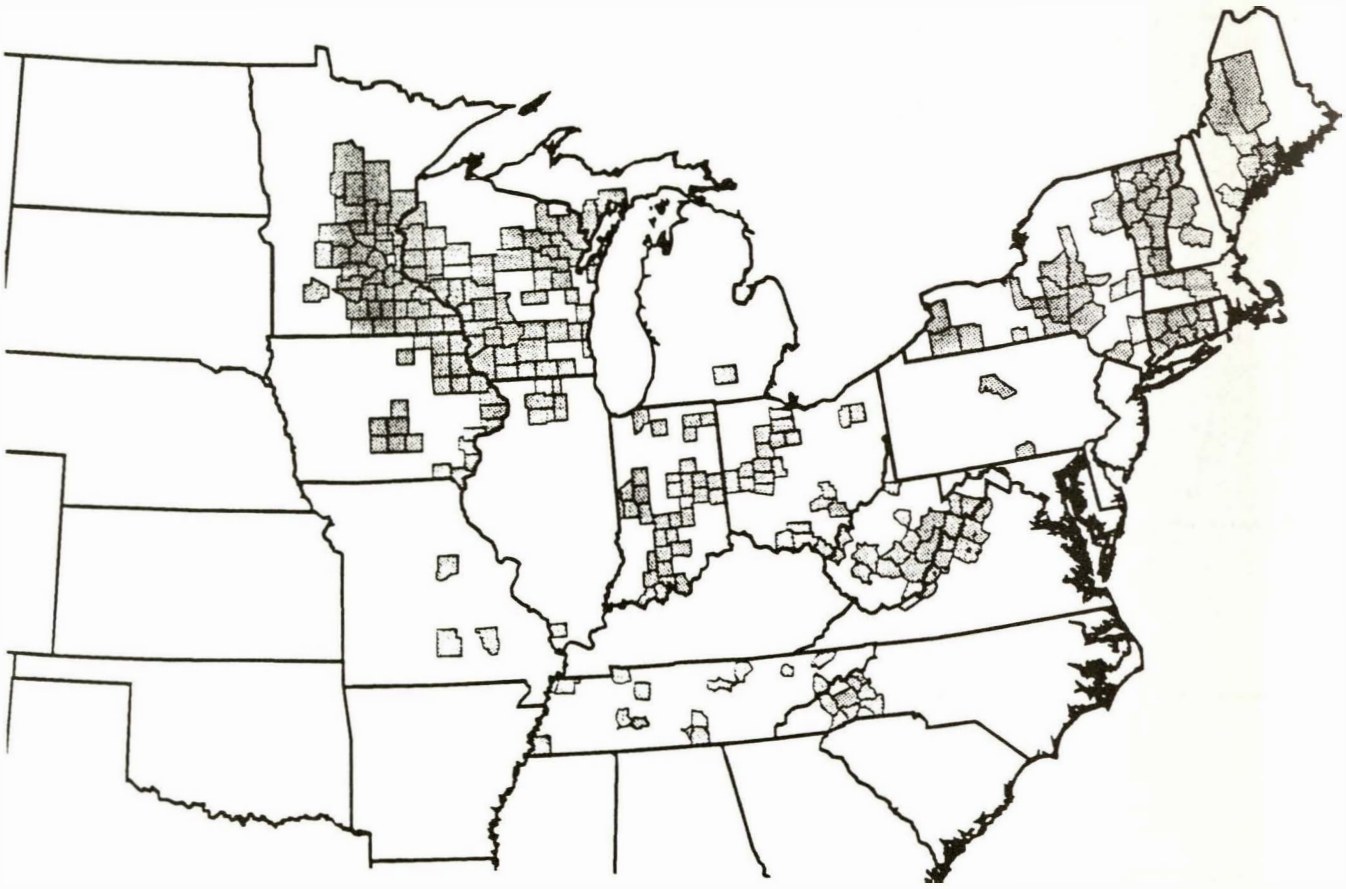
Beech bark disease is the result of an attack by the beech scale *Cryptococcus fagisuga* followed by invasion of the fungus *Nectria coccinea*. About 1890, the scale was accidentally introduced into Eastern Canada. By 1932, the disease was killing trees in Maine and, by 1981, had spread to West Virginia. It is now found in a small area on the North Carolina-Tennessee border.

Counties Where Beech Bark Disease Reported, 1993



Butternut canker is caused by the fungus *Sirococcus clavigignenti-juglandacearum*. The origin of the fungus is unknown. Symptoms of the disease have been recognized since the early 1900's, however, the causal fungus was not identified until the late 1970's. The disease is found throughout much of the range of butternut and is a serious threat to the survival of the tree. The Forest Service and some States have imposed a moratorium on harvesting healthy trees in the hopes of finding resistant stock.

Counties Where Butternut Canker Reported, 1993



Dwarf mistletoes (*Arceuthobium* spp.) are parasitic plants that invade the branches of host trees. Conifers on about 26.9 million acres of western forests are infected. The disease causes reduced tree growth, top killing, and tree mortality. About 180 million cubic feet of wood are lost annually. Most of the volume loss is caused by 7 of the 16 dwarf mistletoe species: those on Douglas-fir, lodgepole pine, true fir, western hemlock, western larch, and 2 species on ponderosa pine.

Acres In West Affected by Dwarf Mistletoes, 1993

State (survey year)	National Forest	Other Federal	State And Private	Total
		Thousand acres		
Alaska *	3,060.0	0.0	340.0	3,400.0
Arizona (85-89)	1,040.0	674.0	25.0	1,739.0
California (80-90)	2,276.0	69.0	1,911.0	4,256.0
Colorado (79,82)	638.0	---	---	638.0
Idaho, North (70-80) **	478.0	10.0	224.0	712.0
Idaho, South (78) **	3,117.5	---	---	3,117.5
Montana (70-80)	1,694.0	123.0	600.0	2,417.0
New Mexico (85-89)	1,140.0	348.0	581.0	2,069.0
Nevada (78)	62.0	---	---	62.0
Oregon (67)	2,703.0	505.0	2,470.0	5,678.0
Utah (78)	455.0	---	---	455.0
Washington (76)	1,137.0	43.0	2,760.0	3,940.0
Wyoming (77,78)	361.5	---	---	361.5
Total	18,162.0	1,772.0	8,911.0	28,845.0

*Commercial acreage only in Alaska. Data based on years of knowledge of the resource and the disease.
**Idaho North is Region 1, and Idaho South is Region 4.

Part 2 Conditions by Damage Agent by Region

Insect Conditions by Region

Insects: Native

Douglas-fir beetle, *Dendroctonus pseudotsugae*

Region 1: Idaho, Montana, Wyoming

Host(s): Douglas-fir

Douglas-fir stands infested by the Douglas-fir beetle declined markedly from 1992 to 1993. Total infestation detected in the Region in 1994 was slightly more than 8,400 acres; 4,900 acres in Montana; 2,000 acres in Idaho; and about 1,500 acres in Yellowstone National Park, Wyoming. This compares to a total of about 24,000 acres infested by this beetle in 1993. It is believed that the reduction in Douglas-fir beetle populations is associated with improved host vigor following years of drought and the affects of the 1988 forest fires. With normal precipitation and the absence of major disturbance factors, we expect Douglas-fir beetle populations to remain low.

Region 2: Colorado, Wyoming

Host(s): Douglas-fir

On the Clarks Fork Ranger District of the Shoshone National Forest in Wyoming, outbreak populations appeared to be declining and many attacks resulted in pitchouts. About 4,000 Douglas-fir trees died in 1993 between Sunlight Basin and Crandall Ranger Station. Mortality along the Colorado Front Range continues, occurring in small, widely scattered groups. Most mortality is on steep, inaccessible slopes where western spruce budworm has defoliated trees over the past decade. In the Gunnison Zone (southwestern Colorado), populations generally remained static at a low level.

Region 3: Arizona, New Mexico

Host(s): Douglas-fir

Douglas-fir beetle-caused mortality was detected on 1,160 acres of mixed conifer forest cover type in 1993 as compared to 1,000 acres in 1992. Mortality occurred on the Cibola National Forest (10 acres), Lincoln National Forest (10 acres), Santa Fe National Forest (10 acres), Apache-Sitgreaves National Forests (10 acres), Coconino National Forest (40 acres), Coronado National Forest (100 acres), and the Kaibab National Forest (10 acres), and the Mescalero Apache Indian Reservation (10 acres), the Navajo Indian Reservation (950 acres), and the Fort Apache Indian Reservation (10 acres). Volume losses were estimated at 93,750 cubic feet.

Insect Conditions by Region

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Insects: Native

Region 4: Idaho, Utah, Wyoming

Host(s): Douglas-fir

Mortality decreased in southern Idaho and Wyoming and increased in Utah. In southern Idaho, 89,900 trees were killed in 1993 compared to 105,500 trees killed in 1992. The largest infestations were located on the Boise, Caribou, Payette, and Sawtooth National Forests. Smaller infestations were located on the Challis, Salmon, and Targhee National Forests. A static to decreasing mortality trend was observed throughout forests in southern Idaho. In Utah, 6,700 trees were killed in 1993, an increase from 5,100 trees killed in 1992. Infestations were located on the Manti-LaSal, Uinta, Wasatch-Cache, and Ashley National Forests. In Wyoming, activity decreased on the Bridger-Teton National Forest where 6,600 trees were killed in 1993, compared to 8,300 trees killed in 1992.

Region 5: California

Host(s): Douglas-fir

Attacks by this beetle were limited, and often associated with drought, dwarf mistletoe infestions, and poor vigor associated with the presence of black stain and armillaria root disease.

Region 6: Oregon, Washington

Host(s): Douglas-fir

Detected Douglas-fir beetle activity decreased significantly throughout the Region, down from 171,928 acres (an average of 1.01 trees per acre) in 1992 to 50,622 acres (an average of 0.60 tree per acre) in 1993. National forests in Region 6 experienced a significant decrease in observed activity with the exception of Mt. Baker-Snoqualmie National Forest, which went from 1,270 reported acres in 1992 to 2,647 in 1993, a continuing affect of a 1990 windthrow. Drought and root diseases contributed to host susceptibility.

Douglas-fir tussock moth, *Orgyia pseudotsugata*

Region 1: Idaho, Montana

Host(s): Douglas-fir, spruce, true firs

Douglas-fir tussock moth populations remained at very low levels in 1993. No aerially visible defoliation was detected. Moth catches in pheromone traps were at, or very near, record low levels in both states. Populations are expected to remain low in 1994.

Region 2: Colorado

Host(s): Douglas-fir, Engelmann spruce

Heavy defoliation was discovered on 250 acres at West Creek, Pike National Forest. Expansion is expected in 1994.

Region 4: Idaho, Utah

Host(s): Douglas-fir, true firs

In 1992, Douglas-fir tussock moth populations collapsed. No defoliation was observed in 1993.

Region 5: California

Host(s): White fir

Populations remain at low, non-damaging levels. Damage did not follow the above-normal levels of moths caught on the Modoc National Forest in 1992.

Region 6: Oregon, Washington

Host(s): Douglas-fir, true firs

Aerial survey detected 46,195 acres of Douglas-fir tussock moth activity (7,546 in 1992); approximately 46,000 acres of activity were detected on the Burns Ranger District of the Malheur National Forest. The difference between 1992 and 1993 reported acres of defoliation could in part be explained by the early summer hail storm in 1992, which destroyed many of the observable signs of defoliation. Results of adult population monitoring in the summer of 1993 indicate a continuing decline in trap catches; negligible amounts of defoliation are expected for 1994.

Elm spanworm, *Ennomos subsignarius*

Region 9/Northeastern Area: New York, Pennsylvania

Host(s): American beech, maple, ash

Over 1 million acres were affected in northwestern Pennsylvania and southwestern New York. Defoliation has occurred for several years in some areas. Aerial suppression projects are planned for 1994 in Pennsylvania on and surrounding the Alleghany National Forest and on the Seneca Indian Lands in New York to reduce the impact from defoliation.

Fir engraver beetle, *Scolytus ventralis*

Region 1: Idaho, Montana

Host(s): Grand fir, subalpine fir

The fir engraver beetle, a pest almost exclusively of grand fir within Region 1, is highly dependent on stressed trees. Populations are often maintained in stands of root-diseased grand fir but become epidemic under droughty conditions. Beetle populations declined in 1993 from 13,900 to 6,400 infested acres in northern Idaho. Most beetle activity was on the Nez Perce National Forest. In Montana, only 187 acres of infestation occurred in 1993. A static to declining trend is anticipated in 1994.

Insects: Native

Region 3: Arizona, New Mexico

Host(s): True firs

Mortality occurred on 2,330 acres of host type in 1993, compared to 2,570 acres in 1992. Mortality on Federal lands included 60 acres on the Cibola National Forest, 10 acres on the Lincoln National Forest, 40 acres on the Santa Fe National Forest, 190 acres on the Apache-Sitgreaves National Forests, 270 acres on the Coconino National Forest, 1,440 acres on the Kaibab National Forest, 20 acres on the Ft. Apache Indian Reservation, 10 acres on the Mescalero Apache Indian Reservation, and 290 acres on the Navajo Indian Reservation. Volume loss was estimated at 246,800 cubic feet.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Grand fir, red fir, subalpine fir, white fir

Regionwide, true fir morality from fir engraver beetle attack increased from 269,800 trees in 1992 to 394,700 trees in 1993. Increasing mortality was observed in Idaho, Nevada, and Wyoming; decreasing mortality was observed in Utah. In Idaho, mortality increased from 41,900 trees in 1992 to 67,200 trees in 1993. Activity was concentrated on the Boise and Payette National Forests. In Utah, 32,800 trees were killed in 1992, while in 1993, 45,100 trees were killed. Tree mortality decreased on the Wasatch-Cache National Forest and increased on the Dixie and Uinta National Forests. On the Bridger-Teton National Forest, 1,400 trees were killed, the first time significant fir engraver beetle activity has been observed in Wyoming. The largest infestation in the Region was located on the Toiyabe National Forest and adjacent State and private land in Nevada where mortality increased from 195,100 trees killed in 1992 to 281,000 trees killed in 1993.

Region 5: California

Host(s): Red fir, white fir

This beetle remained the most significant forest insect in California. Large numbers of trees faded in northern California from attacks in 1992. Stands with 30-to 80-percent mortality were found in Lassen, Modoc, and Siskiyou Counties. Highest levels appear to be in areas that normally receive relatively low precipitation. True firs killed in 1993 have not faded, but inspections indicate a downward trend in mortality. Top-kill and mortality decreased throughout much of the southern Sierra Nevada. However, high levels of mortality continued on the east side of the Lake Tahoe Basin and the Tahoe National Forest, and two areas of the Inyo National Forest.

Region 6: Oregon, Washington

Host(s): True firs

Fir engraver activity increased from 324,931 acres (an average of 1.62 trees per acre) in 1992 to 473,290 acres (an average of 1.25 trees per acre) in 1993. The Fremont National Forest reported 109,365 acres in 1992 and 284,191 in 1993. The Winema National Forest went from 29,941 acres in 1992 to over 75,000 in 1993. Significant decreases of reported activity were also noted in the Malheur (92,372 acres in 1992 to 2,002 acres in 1993)

and the Wallowa-Whitman (25,578 acres in 1992 to 1,896 acres in 1993) National Forests.

Fruittree leafroller, *Archips argyrospilus*

Region 8: Louisiana

Host(s): Bald cypress

The fruittree leafroller defoliated 190,000 acres, causing significant loss in tree growth over 70 percent of the area. The population is moving toward New Orleans and other populated areas.

Jack pine budworm, *Choristoneura pinus pinus*

Region 9/Northeastern Area: Michigan, Minnesota, Wisconsin

Host(s): Jack pine

Populations decreased in Luce County, Michigan, where tree mortality was about 16.5 percent after 2 years of epidemic. About 275 acres of trees were salvaged in 1993. New populations appeared in Marquette County where mortality was projected to be about 18 percent. In the central counties of Minnesota, there was moderate defoliation. Egg mass surveys indicated a declining population in 1994. Infestation and defoliation increased in the eastern counties of the State that border infested areas of Wisconsin. Jack pine budworm caused heavy defoliation on 400,000 acres of Jack pine in northern and central Wisconsin. Salvage harvests were planned in some parts of the State.

Jeffrey pine beetle, *Dendroctonus jeffreyi*

Region 4: Nevada

Host(s): Jeffrey pine

Mortality of Jeffrey pines on the Toiyabe National Forest and adjacent lands in Nevada attributed to attack by Jeffrey pine beetle increased to 20,700 trees killed. Mortality is located throughout the Lake Tahoe Basin in western Nevada.

Region 5: California

Host(s): Jeffrey pine

Many old-growth Jeffrey pine have been killed in and near the northern half of Lassen Volcanic National Park. Pole-size Jeffrey pine also have been killed in some parts of Lassen County. Above-normal levels of mortality continued in several areas around Lake Tahoe and on the Inyo National Forest.

Lodgepole needleminer, *Coleotechnites milleri*

Region 5: California

Host(s): Lodgepole pine

About 500 acres of defoliation were reported on the Stanislaus National Forest, and there are now 35,000 acres of visible defoliation in Yosemite National Park.

Modoc budworm, *Choristoneura retiniana*

Region 5: Northeastern California

Host(s): White fir

Light to moderate damage occurred on about 30,000 acres in the northern Warner Mountains, Modoc County.

Mountain pine beetle, *Dendroctonus ponderosae*

Region 1: Idaho, Montana

Host(s): Lodgepole pine, ponderosa pine, other pines

Mountain pine beetle infested areas declined to their smallest size in over two decades. Just over 51,000 acres were infested in 1993. This was about 2 percent of the nearly 2.5 million acres infested when the infestation reached its peak in the Region in 1981. Of the 1993 total acres infested, approximately 7,700 acres were in northern Idaho. Nearly all of the remaining 43,300 acres were in western Montana.

Though beetle populations are currently low, much susceptible lodgepole pine remains in the Region. As long as suitable hosts are available, the threat of building infestations persists. However, we expect a further decline of the population over the next few years.

Region 2: Colorado, South Dakota, Wyoming

Host(s): Limber pine, lodgepole pine, ponderosa pine

Tree mortality declined significantly in the central Black Hills of South Dakota from 1992 to 1993, nearly an 83-percent reduction. The epidemic near Bear Mountain appeared to be collapsing, with the majority of new attacks being pitched out. About 6,000 ponderosa pines were killed by bark beetles in South Dakota and Wyoming. On the Bighorn National Forest in Wyoming, mortality of limber pine continued in Tensleep Canyon. The outbreak in ponderosa pine at Laramie Peak, Wyoming, dramatically decreased in 1993. A small infestation discovered in 1992 in lodgepole pine continues in 1993 near Lake Granby on the Arapaho National Forest. Several small infestations along the northern front range appear to be increasing. No outbreaks of this pest occurred in the Gunnison Zone (southwestern Colorado) in 1993.

Region 3: New Mexico

Host(s): Ponderosa pine

Mortality was detected on 1,400 acres of host type in 1993 as compared to 1,175 acres in 1992. Mortality occurred on the Santa Fe National Forest (580 acres), the Bandalier National Monument (20 acres), and the Navajo Indian Reservation (800 acres). Volume losses were estimated at 93,250 cubic feet.

Region 4: Idaho, Utah, Wyoming

Host(s): Lodgepole pine, ponderosa pine, whitebark pine

Increases in tree mortality of lodgepole pine and ponderosa pine occurred in southern Idaho and Utah, while decreases in mortality occurred in western Wyoming. In southern Idaho, 41,300 trees were killed in 1993, compared to 10,500 trees killed in 1992. The largest single area of tree mortality was located within the Sawtooth National Recreation Area on the Sawtooth National Forest. Smaller outbreaks were located on all other National Forests in southern Idaho. In Utah, 11,500 trees were killed. The largest area of mortality was located on the Dixie National Forest in southern Utah where 7,700 trees were killed. Elsewhere, smaller outbreaks were located on all other National Forests in Utah. A decrease in mountain pine beetle activity occurred in western Wyoming, on the Bridger-Teton National Forest, where 900 trees were killed in 1993, compared to 2,700 in 1992.

Increases in mountain pine beetle activity in whitebark pine occurred in Idaho and western Wyoming. On the Payette National Forest in southern Idaho, 2,000 dying trees were detected, while on the Bridger-Teton National Forest in western Wyoming, 500 dying trees were detected. Smaller, less extensive infestations occurred in Utah and Nevada.

Region 5: California

Host(s): Lodgepole pine, ponderosa pine, sugar pine

Mortality in the larger size classes of sugar pine was widely scattered across northern California in Siskiyou, Shasta, Lassen, and Plumas Counties. The beetle also caused mortality of lodgepole pine in Siskiyou, Lassen, and eastern Shasta Counties. In the Sierras, mortality of sugar pine increased in Yosemite National Park and in parts of the Sequoia and Sierra National Forests. Attacks on lodgepole were reported from locations around Lake Tahoe.

Region 6: Oregon, Washington

Host(s): Jeffrey pine, lodgepole pine, ponderosa pine, sugar pine, western white pine

Acres affected by mountain pine beetle increased from 428,569 acres (an average of 1.39 trees per acre) in 1992 to 546,115 (an average of 1.44 trees/acre) in 1993. Notable increases in acreage affected in ponderosa pine were detected on the Deschutes, Malheur, and Ochoco National Forests (an approximate combined total of 79,000 acres in 1992, up to 140,000 in 1993). Increased activity in lodgepole pine was reported on the Deschutes, Fremont, and Okanogan National Forests. Acres of moun-

tain pine beetle activity detected in western white pine doubled on the Wenatchee and Colville National Forests (13,033 acres in 1992; 25,511 in 1993).

Pandora moth, *Coloradia pandora*

Region 6: Oregon

Host(s): Lodgepole pine, ponderosa pine

The current pandora moth infestation in central Oregon is entering its fifth generation. Defoliation, which occurs in even-numbered years, has increased with every generation since the infestation began in 1988. Most recently, over 77,000 acres were defoliated in 1992. Record numbers of moths were reported in 1993 in the communities of Bend, Sunriver, and LaPine. Egg hatch and larval survival have been high, which may mean another year of heavy and widespread defoliation in 1994.

Pine engraver beetle, *Ips* spp.

Region 1: Idaho, Montana, Wyoming

Host(s): Lodgepole pine, ponderosa pine

Although *Ips pini* are most frequently a problem of ponderosa pine in Region 1, outbreaks sometimes occur in lodgepole pine following some type of stand disturbance. Serious outbreaks and subsequent killing of standing lodgepole pines occurred in and around Yellowstone National Park following the fires of 1988. These populations are finally declining–in response, for the most part, to improved moisture conditions. Where more than 27,000 acres had been infested on the Gallatin National Forest, Montana, in 1992, only 5,900 acres were recorded in 1993. Another 1,600 acres of infestation occurred in other parts of eastern Montana. In 1993, about 500 acres of infestation occurred in northern Idaho near Coeur d'Alene.

Region 2: South Dakota, Wyoming, Colorado

Host(s): Lodgepole pine, ponderosa pine

Small pockets of top-killing and tree mortality continued throughout the Black Hills on ponderosa pine, but these were less abundant in most areas than in preceding years. Pheromone traps were placed in stands being thinned in the southern Black Hills where *Ips pini* populations were unusually high. *I. pini* continue to kill ornamental pine and spruce along the front range, especially the Denver area.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Ips spp. beetle-caused mortality was detected on 1,630 acres of ponderosa pine forest cover type in 1993, as compared to 2,135 acres in 1992. Mor-

tality occured on the Cibola National Forest (50 acres), Gila National Forest (660 acres), Lincoln National Forest (360 acres), Santa Fe National Forest (90 acres), Apache-Sitgreaves National Forest (40 acres), Coconino National Forest (130 acres), Coronado National Forest (20 acres), Kaibab National Forest (90 acres), Prescott National Forest (50 acres), Tonto National Forest (70 acres), the Navajo Indian Reservation (40 acres), the Santa Clara Indian Reservation (10 acres), the San Carlos Indian Reservation (10 acres), and the Hualupai Indian Reservation (10 acres). Volume losses were estimated at 114,150 cubic feet.

Region 4: Idaho, Nevada, Utah

Host(s): Lodgepole pine, ponderosa pine

Activity of *Ips pini*, often associated with western pine beetle and Jeffrey pine beetle, increased on the Boise and Payette National Forests in southern Idaho. In Utah, populations exist in the slash of ponderosa and lodgepole pine.

Region 5: California

Host(s): Pines

Winter storms caused locally abundant green slash from breakage and blowdown, but little subsequent top-kill or mortality could be attributed to pine engravers (*Ips* spp.) in either northern California or the Sierra Nevada region in 1993.

Region 6: Oregon, Washington

Host(s): Ponderosa pine

Aerially detected pine engraver (*Ips* spp.) activity increased for the third straight year, from 2,651 acres in 1991 to a 3-year high of 23,179 acres in 1993. Activity on 4,600 acres was reported on the Wallowa-Whitman National Forest, with an additional 3,400 acres of activity on private land within the reporting area. Central Oregon reported over 4,800 acres of activity on private land, the largest reported acreage in over 5 years for this area.

Region 8: Regionwide

Host(s): Southern pines

In 1993, pine engraver beetle (*Ips avulsus*, *I. calligraphus*, and *I. grandicollis*) caused-mortality was significantly above average throughout Region 8 due to a summer drought. The hot, dry conditions led to increased activity in Alabama, Mississippi, South Carolina, Texas, and eastern Oklahoma. High levels of pine mortality also occurred in storm-damaged areas in Florida; the Piedmont of Georgia and North Carolina; and southwest and north central Tennessee. In Louisiana, engraver beetles killed over 5,000,000 board feet of timber.

Roundheaded pine beetle, *Dendroctonus adjunctus*

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Roundheaded pine beetle mortality was detected on 34,170 acres of ponderosa pine type in 1993, as compared to 22,190 acres in 1992. Most of the mortality occured in the Sacramento Mountains of New Mexico, including 15,370 acres on the Lincoln National Forest and 16,750 acres on the Mescalero Apache Indian Reservation. Mortality in Arizona occured on 2,050 acres of the Coronado National Forest. Volume losses were estimated at 1,878,500 cubic feet.

Southern pine beetle, *Dendroctonus frontalis*

Region 8: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia

Host(s): Southern pines

Compared to 1992, the number of southern pine beetle infestations in Region 8 increased by 23 percent, but the number of affected acres declined by 27 percent. The most significant activity occurred in Virginia, which had a 66-percent increase in the number of affected acres and an 80-percent increase in the number of infestations. The number of infestations, 18,531, was the largest ever recorded for that State.

Populations declined along the Gulf Coastal Plain, including the States of Alabama, Mississippi, Louisiana, and Texas. The decline in Texas is minimal, with the activity mainly concentrated near the eastern border of the State. South Carolina experienced a 30-to 50-percent decrease, while Georgia had a similar 50-to 60-percent decrease.

Arkansas reported 2,351 infestations, a 60-percent increase in the number of spots, and a 90-percent increase in acreage affected; eastern Oklahoma had an increasing number of spots. North Carolina populations showed increases of 34 percent in acres affected and 52 percent in the number of infestations.

Southern pine beetle populations in the wildernesses within the National Forests in Texas continued to cause significant tree mortality, threatening or, in some cases, moving onto adjacent private land. From 1990 to 1992, a large number of the endangered red-cockaded woodpecker nesting and roosting sites were attacked in the fall season by dispersing beetles. Fewer woodpecker cavity trees were attacked in 1993.

Region 9/Northeastern Area: Delaware, Maryland, West Virginia

Host(s): Loblolly pine, pitch pine, Virginia pine

There were about 1,400 acres of damage in Delaware. Some areas were scheduled for salvage harvesting. Population levels rose in Maryland, and

now affect 2,000 acres in that State. About 500 acres of damage were detected from aerial survey in West Virginia.

Spruce beetle, *Dendroctonus rufipennis*

Region 1: Idaho, Montana

Host(s): Engelmann spruce

Spruce beetle populations are at quite low levels throughout Region 1 with the exception of an ongoing outbreak on the Gallatin National Forest, Montana. That epidemic developed in fire-weakened trees in and near Yellowstone National Park, and is continuing in larger-diameter, old spruce. This outbreak covers about 300 acres and is still threatening a large number of trees on national forest and private land.

Region 2: Colorado, Wyoming

Host(s): Engelmann spruce

A small infestation in standing trees was discovered on the Routt National Forest in Colorado and was subsequently salvage logged in 1993. The population had developed in road right-of-way log decks. Monitoring was conducted on several proposed and existing timber sales in southwestern Colorado. It has been found in the Evergreen area in large diameter spruce, especially those affected by high water in spring where soil was washed from root systems. In Wyoming, population levels were low.

Region 3: Arizona, New Mexico

Host(s): Spruce

Spruce beetle-caused mortality occured on 1,180 acres of host type in 1993, as compared to 1,035 acres in 1992. Mortality was detected on the Cibola National Forest (90 acres), Lincoln National Forest (50 acres), Santa Fe National Forest (240 acres), Coronado National Forest (10 acres), Kaibab National Forest (20 acres), the Mescalero Apache Indian Reservation (10 acres), and the Navajo Indian Reservation (760 acres). Volume losses were estimated at 62,500 cubic feet.

Region 4: Idaho, Utah, Wyoming

Host(s): Spruce

Mortality from spruce beetle infestation remained static during 1993, with 58,200 dying trees observed Regionwide. In Idaho, 35,600 trees were killed on the Payette National Forest, the largest infestation in the Region. In Utah, 21,800 trees were killed on the Manti-LaSal and Dixie National Forests, while a smaller outbreak, located on the Fishlake National Forest, killed 700 trees. No significant spruce beetle activity was observed on the Bridger-Teton National Forest in Wyoming.

Insects: Native

Region 5: California

Host(s): Sitka spruce

No further mortality pockets occurred near Patrick's Point State Park, Humboldt County.

Region 6: Oregon, Washington

Host(s): Engelmann spruce

No significant activity was reported in 1993.

Region 9/Northeastern Area: Maine, New York

Host(s): Red spruce, white spruce

Aerial and ground surveys did not show significant incidence of new spruce beetle attack in Maine except in the coastal area and islands of Hancock County. The trees in the new outbreak area were either old or under stress from insect damage or poor growing sites. There were a few trees scattered throughout the State near old infested areas that showed evidence of new attack. Spruce stands where infestation has been severe in the past few years were either salvaged or in advanced stages of decay. Populations are not expected to rise in 1994. New York reported a high percentage of spruce mortality due to increased attacks by eastern spruce beetle.

Region 10: Alaska

Host(s): Lutz spruce, Sitka spruce, white spruce

Acreage of active tree mortality from spruce beetle has incrementally increased, from 177,000 acres in 1989 to over 700,000 acres in 1993. An exceptionally warm spring and summer in 1993 (for the fifth consecutive year) continued to lend impetus to the expanding outbreaks. Infestation levels are expected to top the million-acre mark next year. In 1993, an estimated 68 million trees were killed in Alaska by this insect. Many ownerships are being affected, with more than three-fourths of the infestations occurring on State and private lands. There are numerous impacts associated with these infestations, including: (1) loss of merchantable value of killed trees; (2) long-term ecosystem conversion; (3) impacts to wildlife habitat; (4) impacts to scenic quality; (5) fire hazard; and (6) impacts to watersheds/fisheries. This infestation is primarily located in southcentral and interior Alaska; however, over 20,000 acres are active in southeast Alaska, affecting State landholdings and Glacier Bay National Park.

Spruce budworm, *Choristoneura* spp.

Region 9/Northeastern Area: Maine, Michigan, Minnesota, New Hampshire, New York, Vermont

Host(s): Balsam fir, spruce

No significant populations of spruce budworm (*Choristoneura fumiferana*) were detected in Maine in 1993. A statewide network of light and pheromone traps produced a low number of catches of budworm moths. Populations declined significantly in Cook County, Minnesota, but increased in the counties surrounding the town of Ely where mortality be-

came detectable. The infestation is spreading westward primarily on white spruce plantations. The insect was present in Vermont but there was no visible defoliation. No significant activity was reported in New Hampshire or New York.

Region 10: Alaska

Host(s): Lutz spruce, white spruce

Spruce budworm (*Choristoneura fumiferana*, *C. orae*) populations dramatically decreased in 1993 after almost 2 years of rapid and extensive increases in defoliation levels. Approximately 32,481 acres of defoliated spruce were observed this year versus more than 180,000 acres of defoliation detected in 1992. The majority of the defoliation occurred on State and private lands near Fairbanks, in interior Alaska. Impact studies were initiated in interior Alaska. Budworm populations are expected to decline further in 1994.

Western balsam bark beetle, *Dryocoetes confusus*

Region 4: Idaho, Utah, Wyoming

Host(s): Subalpine fir

Increases in mortality occurred Regionwide, with 396,200 dying subalpine fir observed. In southern Idaho, 146,200 trees were killed and extensive areas of the Caribou, Sawtooth, and Targhee National Forests are infested. Smaller infestations occurred on the Boise, Challis, and Salmon National Forests. In Utah, 125,700 trees were killed. Mortality was located on the Manti LaSal, Uinta, and Wasatch Cache National Forests. On the Bridger-Teton National Forest in western Wyoming, 124,300 trees were killed.

Western black-headed budworm, *Acleris gloverana*

Region 10: Alaska

Host(s): Mountain hemlock, western hemlock, Sitka spruce

Over 258,000 acres of host type were defoliated in southeast Alaska in 1993, compared to 87,000 acres in 1992. Defoliation was noted on the Tongass National Forest, on lands managed by the BLM, native corporations, and the State of Alaska, and within several communities. Top-kill was evident in some areas, following 2 consecutive years of heavy defoliation. Impact studies were initiated in second-growth stands on the Tongass National Forest. Budworm populations and resulting defoliation are expected to continue to increase throughout southeast Alaska in 1994. Some mortality and growth loss is occurring; however, the major impact to date has been loss of aesthetic quality in and around communities dependant upon the tourism industry.

Western hemlock looper, *Lambdina fiscellaria lugubrosa*

Region 6: Oregon, Washington

Host(s): Douglas-fir, Pacific silver fir, Sitka spruce, western hemlock

Western hemlock looper-caused defoliation was detected on 1,412 acres of North Cascades National Park and on 47,806 acres of the Mt. Baker-Snoqualmie National Forest. The majority of the defoliation was detected on the Darrington and Mt. Baker Ranger Districts. This represents the first significant reporting of hemlock looper activity in several years.

Western pine beetle, *Dendroctonus brevicomis*

Region 1: Idaho, Montana

Host(s): Ponderosa pine

Western pine beetle infestations almost doubled in Region 1 from 1992 to 1993. Nearly 4,000 acres were detected in northern Idaho, mostly in small, widely scattered groups. Another 1,200 acres of infestation occurred in western Montana.

Region 2: Colorado

Host(s): Ponderosa pine

No significant activity reported in 1993.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Mortality occurred on 2,300 acres of host type in 1993, compared to 22,355 acres in 1992. Mortality on Federal lands included 1,490 acres on the Cibola National Forest, 250 acres on the Gila National Forest, 170 acres on the Apache-Sitgreaves National Forests, 80 acres on the Kaibab National Forest, 300 acres on the Tonto National Forest, and 10 acres on the Ft. Apache Indian Reservation. Volume loss was estimated at 128,000 cubic feet.

Region 4: Idaho

Host(s): Ponderosa pine

Western pine beetle activity, often associated with pine engraver beetle activity, increased on the Boise and Payette National Forests with 18,500 trees killed in 1993.

Region 5: California

Host(s): Coulter pine, Ponderosa pine

Mortality was scattered on the North Coast, while losses remained high in the rest of northern California. These losses were primarily from at-

tacks in 1992. New attacks declined from the levels of the past 2 or 3 years. Scattered small group (< 10 trees) kills continued in the lower-to mid-elevation pine and mixed-conifer types in the Sierra Nevada region. Mortality in Southern California was at low or near "normal" levels.

Region 6: Oregon, Washington

Host(s): Ponderosa pine

Reported western pine beetle activity increased in acreage in Oregon from 121,084 acres in 1992 (an average of 0.77 tree per acre) to 162,838 acres in 1993 (an average of 0.21 tree per acre). An additional 27,890 acres (0.34 tree per acre) were reported in pole-size trees.

Washington experienced a substantial gain in reported activity acreage, with the bulk occurring in second growth, pole-sized stands of ponderosa pine: 12,650 acres (0.85 tree per acre) in 1992; 161,511 acres (1.13 trees per acre) in 1993. Western pine beetle activity in mature ponderosa pine was reported on 23,252 acres (0.31 tree per acre) in Washington.

The Malheur, Ochoco, and Wallowa-Whitman National Forests and the Colville and Yakima Indian Reservations had substantial increases in the number of reported activity acres.

Observed activity on the Mt. Hood and Fremont National Forests decreased.

Western spruce budworm, *Choristoneura occidentalis*

Region 1: Idaho, Montana

Host(s): Douglas-fir, Engelmann spruce, true firs

Western spruce budworm-caused defoliation fell to its lowest level in northern Idaho and Montana since recordkeeping began in 1948. Aerial surveys detected only 44,280 acres of mostly light defoliation in Montana, and just 730 acres in northern Idaho. This compares to 941,320 and 58,000 acres in Montana and Idaho, respectively, in 1992: a 95-percent reduction. We attribute the dramatic population decline to the near record-setting cool, wet spring and summer of 1993. This adversely affected budworm dispersal as larvae and moths, as well as extended their overall developmental period. We anticipate populations to begin rebuilding, yet remain low in 1994, given a return to more normal weather patterns.

Region 2: Colorado, Wyoming

Host(s): Douglas-fir, Engelmann spruce, subalpine fir, white fir

Defoliation of mixed conifer and subalpine forests continued in southwestern Colorado in 1993. Most of the defoliation occurred on the Salida District of the San Isabel National Forest, on the Creede and Del Norte Districts of the Rio Grande National Forest, on the Ouray and Paonia Districts of the Gunnison National Forest, the Rifle District of the White

River National Forest, and on National Park Service lands in Gunnison County. The activity in these areas is expected to continue into 1994. Areas along the Front Range on the Pike National Forest and adjacent intermingled State and private lands experienced moderate defoliation. Defoliation was negligible in 1993 in Wyoming.

Region 3: Arizona, New Mexico

Host(s): Douglas-fir, spruce, true firs

Defoliation was detected on 66,400 acres of host type in 1993, compared to 20,960 acres in 1992. Defoliation on Federal lands included 11,720 on the Carson National Forest, 240 acres on the Lincoln National Forest, 20,200 acres on the Santa Fe National Forest, 80 acres on the Jicarilla Apache Indian Reservation, 1,520 acres on the Navajo Indian Reservation, 200 acres on the Santa Clara Indian Reservation, and 800 acres on the Taos Pueblo Indian Reservation. An additional 31,640 acres of defoliation occurred on State and private land in New Mexico. No western spruce budworm defoliation was detected in Arizona.

Region 4: Idaho

Host(s): Douglas-fir, true firs

About 225 acres of light defoliation was observed on the Challis National Forest.

Region 6: Oregon, Washington

Host(s): Douglas-fir, Engelmann spruce, true firs, western larch

Areas of visible defoliation continued to decline Regionwide. Total acres reported for 1993 were 331,529, compared to over 3 million reported in 1992. Over 70 percent of the defoliation was detected in Washington, with 95 percent of that being classified in the "light effects" category. An aerial suppression project using *Bacillus thuringiensis* was conducted on 64,182 acres of the Warm Springs Indian Reservation.

Populations in the Blue Mountains have been reduced to low levels, which caused no detectable defoliation.

The Central Oregon area reported that, even though budworm populations decreased dramatically in 1993, there was a substantial increase in tree mortality in some of the areas that have sustained repeated defoliation since the late 1980's. In previous years, most defoliated trees recovered, and cumulative mortality along the Cascade Mountain foothills was limited. In the spring of 1993, many of these defoliated trees did not recover, and mortality may now approach 40 percent in some localized areas. Most of these dead trees are found at mid to high elevations below the Cascade crest, on the Sisters Ranger District of the Deschutes National Forest and the Warm Springs Indian Reservation. Affected tree species include Douglas-fir and grand fir. Both species show signs of long-term infection by armillaria root disease, and Douglas-firs have also been attacked by the Douglas-fir beetle.

Insects: Nonnative

A leafhopper,
Sophonia rufofascia

Region 5: Oahu (1987), Hawaii (1989), Kauai (1990), Lanai (1991), Maui (1992) Islands, Hawaii

Host(s): Numerous, including native plants

Thus far, 235 species (30 natives) in 72 plant families are being affected. This introduced insect is a suspect in the die-off of Uluhe fern and other plant species, such as Acacia koa. Studies have begun to investigate the relevance of mycoplasma-like agents recently found yellowing guava and macadamia plants.

Balsam woolly adelgid,
Adelges piceae

Region 1: Idaho

Host(s): Grand fir, subalpine fir

Balsam woolly adelgid populations continue to grow in infested portions of northern Idaho. The precise number of acres infested in 1993 is unknown because some of the outbreak areas were not aerially surveyed. However, observations indicate an increase from the 17,000 acres infested in 1992. Areas of greatest damage are on the Nez Perce, Clearwater, and Idaho Panhandle National Forests. Although mortality to larger trees is limited to subalpine fir, regeneration of both fir species is being killed. In some areas, the adelgid has killed up to 75 percent of the fir regeneration.

Region 6: Oregon, Washington

Host(s): True firs

Balsam woolly adelgid activity was observed on 16,424 acres in the State of Washington in 1993; a similar level to 1991, but approximately double the 1992 level. The majority of the acres reported were on the Mt. Baker-Snoqualmie and Olympic National Forests.

Region 8: North Carolina, Tennessee, Virginia

Host(s): Fraser fir

Fraser fir has a limited range and occurs predominantly on the highest mountains of the Southern Appalachians. The host occurs in pure stands on the highest peaks or in a mixture with red spruce at lower elevations. Since the introduction of the balsam woolly adelgid, 64,700 acres of this forest type have been affected. The insect prefers larger fir trees, and this has lead to the demise of almost all mature host trees within the affected areas. Adelgid populations were high again in 1993 and mortality continues throughout the range of Fraser fir in Southern Appalachian Mountains.

Insects: Nonnative

Region 9/Northeastern Area: Maine, Vermont, West Virginia

Host(s): Balsam fir

Infestation was detected in two new counties and at new sites in the previously infested Tucker County in West Virginia. No significant activity was reported in Maine or Vermont.

Common European pine shoot beetle, *Tomicus piniperda*

Region 9/Northeastern Area: Illinois, Indiana, Michigan, New York, Ohio, Pennsylvania

Host(s): Scotch pine

The beetle, native to Europe and Asia, was discovered near Cleveland, Ohio, in 1992. It has since been found in 6 States bordering the Great Lakes, and in Ontario, Canada. The USDA Animal and Plant Health Inspection Service (APHIS) and the States have issued regulations affecting 91 counties to prevent spread of the beetle. The regulations affect the movement of Christmas trees and other forest products from infested areas.

Gypsy moth-Asian, *Lymantria dispar*

Region 8: North Carolina

Host(s): Alder, larch, oak, poplar, willow, other hardwoods, some evergreens

Adult Asian gypsy moths were accidentally released at the Military Ocean Terminal at Sunny Point, North Carolina. Hundreds of male moths, European strain, Asian strain, and hybrids, were captured in pheromone traps after the accidental introduction. An eradication project is planned for 1994. The Asian gypsy moth could cause more serious economic and environmental consequences than the European strain due to its wider range of host species and potential to spread more rapidly with flying females.

Gypsy moth-European, *Lymantria dispar*

Region 1: Idaho, Montana, North Dakota, Wyoming

Host(s): Hardwoods

Cooperative detection monitoring for the gypsy moth with APHIS, State Departments of Agriculture, Forestry, and Lands continued in 1993. A network of strategically located pheromone-baited traps were placed throughout all States in Region 1. In 1992, two gypsy moths were captured in northern Idaho near Coeur d'Alene, and one moth was caught in Montana near Billings. A more intense delimitation survey will be conducted at the sites of these moth catches in 1994.

Region 2: Colorado, Kansas, Nebraska, South Dakota, Wyoming

Host(s): Hardwoods

In South Dakota, ten moths were caught in delimitation and detection survey traps located in Pennington, Fall River, Lawrence, and Minnehaha Counties. No established populations have been confirmed yet. In Nebraska, ten moths were caught in detection traps in Douglas, Sarpy, and Lancaster Counties. In Wyoming, one moth was caught on the Wapiti Ranger District of the Shoshone National Forest. Six moths were caught at four sites in Colorado in 1993: one in Boulder, one in Colorado Springs, one in Denver, and three in Lakewood. No moths were caught in traps placed in predominantly developed recreational sites on the Medicine Bow National Forest in Wyoming and on the Arapaho, Roosevelt, and Pike National Forests in Colorado. Gypsy moths were caught in traps at two sites in Kansas: one in the Kansas City area and one in Dodge City.

Region 4: Utah

Hosts: Various deciduous species

In the fifth year of the Utah Gypsy Moth Eradication Project, approximately 5,100 acres were treated. The treatment efforts resulted in no moth catches within the treatment areas. Five moths were detected in Utah outside the treatment area.

Region 5: California

Host(s): Many kinds of trees and ornamentals

Approximately 21,000 traps captured 12 moths in 7 counties.

Region 6: Oregon, Washington

Host(s): Apple, oaks, sweetgum, other hardwoods

While no defoliation has been observed in either State, pheromone traps continue to catch single moths, and, in some cases, multiple moths. These catches represent new introductions or populations not completely eradicated by the eradication treatments. Based on trap catches, proposals are being developed to apply eradication treatments from the ground in four areas in Washington and two in Oregon. One additional eradication treatment area in Oregon may be treated from the air. It is expected that new introductions will continue as long as populations in the East persist and people are moving from the generally infested area to the Pacific Northwest. Two moths in Oregon and one in Washington have been identified as a hybrid between the Asian strain and the European strain. One of the hybrid catch sites in Oregon may be included in the aerial eradication treatment.

Region 8: Arkansas, Georgia, North Carolina, Tennessee, Virginia

Host(s): Apple, oaks, sweetgum, other hardwoods

Defoliation occurred on 589,100 acres of host type in 1993, compared to 748,000 acres in 1992. Virus and fungal (*Entomophaga maimaiga*) infections caused a moth population collapse within the infested portions of Virginia. Defoliation on Federal lands included 131,303 on the George Washington National Forest and 88,166 acres on other Federal lands.

Treatments within the quarantine area covered 82,354 acres, while 217,000 acres were treated in 1992. Treatments are mainly limited to forested residential areas to reduce the impact to the visual or aesthetic benefits of the trees. The average rate of spread of the gypsy moth along the expanding front is 8 to 12 miles per year. In North Carolina, 3,560 acres were treated with *Bt.* to suppress low-density populations of gypsy moth as part of the Gypsy Moth Slow-the-Spread Pilot Project.

In Region 8, isolated European gypsy moth infestations outside of the quarantine area were treated in Arkansas, Georgia, and Tennessee. In Arkansas, 600 acres of private land were treated. Post-eradication trapping indicated that the insect had spread beyond this original infestation. Follow-up treatment is proposed for 1994. An additional 1,937 acres were treated in Georgia; trapping indicated that the treatment was successful. No treatment is planned for 1994. In Tennessee, two isolated infestations totaling 995 acres were treated. No additional treatment will be made in 1994; however, post-eradication monitoring will continue.

Male moths were trapped in all States Regionwide.

Region 9/Northeastern Area: Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin

Host(s): Oaks, other hardwoods

No defoliation was detected by aerial survey in Connecticut in contrast to almost 32,000 acres detected in 1992. Defoliation increased in Delaware, where light to severe damage was reported on almost 27,000 acres. In Illinois, increased numbers of moths were caught in traps but no damage was reported. Surveys and trap catches in Indiana indicated the "advancing front" of gypsy moths was approaching the State. No significant activity was reported in Iowa or Minnesota. Gypsy moth populations collapsed in Maine, where levels were expected to be endemic in 1994. In Maryland, the acres of defoliation nearly doubled to almost 69,000. The areas of defoliation declined in most counties of Massachusetts. Michigan reported that defoliation decreased significantly in 1993, possibly as a result of virus activity and the establishment of the *Entomophaga* fungus. Declining moth populations were reported in Missouri. Infestation also dropped significantly in New Hampshire. Problems caused by gypsy moths intensified in New Jersey, and treatments were planned for 1994 in affected counties. Aerial detection in New York showed very little damage, except for the central part of the State, where treatment was planned for 2,000 acres of Seneca Nation land in 1994. Only 600 acres of defoliation were reported in Ohio. Defoliation decreased to just over 300,000 acres in Pennsylvania, where over 100,000 acres were treated in 1993. No defoliation was detected in Rhode Island or Vermont. Damage was variable on over 200,000 acres in West Virginia, an increase from 1992. In Wisconsin, over 35,000 acres were sprayed in 1993. There were nine areas of new infestation.

Hemlock woolly adelgid,
Adelges tsugae

Region 8: Virginia

Host(s): Hemlock

The hemlock woolly adelgid was first reported in the United States in 1920 on the West Coast. A second introduction occurred on the East Coast near Richmond, Virginia, in 1950. The insect has successfully colonized eastern hemlock, causing mortality within 3 to 5 years. The hemlock woolly adelgid threatens the entire range of eastern hemlock. Most of the hemlock type in Virginia is generally infested, except for southwestern counties; decline and mortality are extensive. Much of the hemlock resource is located in riparian areas and makes the impact of this insect pest significant on stream protection, recreation, and deer yards.

Region 9/Northeastern Area: Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia

Host(s): Eastern hemlock

In 1993, adelgid was found in 131 towns in Connecticut, an increase from 129 towns in 1992. Eleven new communities were infested in Massachusetts. New Jersey reported infestation on almost 18,000 acres out of a total of 25,600 acres of hemlock. The insect continued to affect hemlock in southeastern New York, and population levels increased in some counties. About 6,500 acres of damage were reported in Pennsylvania. Hemlock woolly adelgid continued to infest trees in Rhode Island; the insect was expected to expand northward and more inland. A survey was conducted in Windsor County, Vermont, but no populations have been observed in Vermont since 1991. In West Virginia, the existing infestation expanded into new locations and counties. No significant activity was reported in Delaware or Maryland.

Pear thrips,
Taeniothrips inconsequens

Region9/Northeastern Area: New York, Ohio, Pennsylvania, Vermont

Host(s): Sugar maple

Pear thrips defoliation continues in the northeast, although populations are down from the 1980's, when the most extensive damage occurred. The area affected is still significant, with over 600,000 acres in New York, 76,000 acres in Pennsylvania, and 83,000 acres in Vermont, where damage was heavier than it has been in the last 3 years. About 200 acres were reported in Ohio. Pear thrips caused no significant damage in other States previously affected.

Disease Conditions by Region

Diseases: Native

Annosus root disease, *Heterobasidion annosum*

Region 1: Idaho, Montana

Host(s): Douglas-fir, grand fir, ponderosa pine, subalpine fir, western hemlock

Annosus root disease was common in ponderosa pine stands on the Flathead Indian Reservation and in other western Montana locations. It was widespread on Douglas-fir and true firs on the Clearwater, Nez Perce, and the Idaho Panhandle National Forests in Idaho.

Region 2: Colorado, Nebraska

Host(s): Ponderosa pine, white fir

The disease was reported as a factor affecting management of mixed conifer stands on the Southern Ute Reservation and in white fir in the Amphitheater Campground on the Uncompahgre National Forest. Detailed assessments of annosus root disease impacts were carried out in the mixed conifer stands on the Southern Ute Reservation.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine, true firs

Root diseases and their associated pests are responsible for about one-third of the conifer mortality Regionwide. *Heterobasidium annosum* accounts for about 20 percent of this mortality. In 1993, *H. annosum* was observed in many white fir trees attacked by fir engraver beetles on the North Kaibab Ranger District.

Region 4: Idaho, Nevada, Utah, Wyoming, California

Host(s): Douglas-fir, Engelmann spruce, Jeffrey pine, lodgepole pine, ponderosa pine, true firs

Infection causes varying amounts of root and butt rot in mature individuals of many tree species, and may result in predisposition to windthrow and/or beetle attack. In grand fir and subalpine fir, it is commonly found as a butt rot. Infection-induced mortality occurs occasionally in young ponderosa pine and seldom in other hosts.

Region 5: California

Host(s): Conifers, some hardwoods

Approximately 1.6 million acres of pine and 0.8 million acres of true fir type are infested with this root and butt rot. The disease infects trees through stumps and wounds and then slowly spreads to neighboring trees.

The disease decays tree roots and butts and increases susceptibility to bark beetle attack.

Region 6: Oregon, Washington

Host(s): Ponderosa pine, true firs, western hemlock

Annosus root disease was responsible for losses in many partially cut white and grand fir stands in southern and eastern Oregon and eastern Washington. Mortality was high where annosus root disease and fir engraver beetles operate as a complex. In eastern portions of the Region where many stands were cut 10-20 years ago, trees surrounding cut stumps are dying. Disease severity is expected to increase with time. Using stump treatments to protect recently cut white fir stumps from colonization by the fungus is policy on the Wallowa-Whitman National Forest. Annosus root disease was observed with increasing frequency in predominantly ponderosa pine stands on drier sites in eastern Washington and Oregon. The potential impacts of annosus root disease on mountain hemlock and Pacific silver fir in high elevation stands in the Cascade Range continue to concern resource managers. Annosus root disease in low elevation western hemlock stands primarily causes butt rot; impacts are considered low unless stands are managed at rotations greater than 120 years.

Region 8: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia

Host(s): Eastern white pine, loblolly pine, longleaf pine, shortleaf pine, slash pine

Annosus root disease continued to cause significant losses of its pine host in Region 8. Mortality and growth losses range from 2 percent to 20 percent of growing stock volume of managed high risk stands across the south. The disease is most often associated with thinned pine plantations on sandy, well-drained sites; but can be found on a variety of sites, soils, and forest conditions. Bark beetle infestations frequently occur within infected stands.

Region 9/Northeastern Area: Maine

Host(s): Red pine

In Maine, this is primarily a disease of plantation pine. As in almost every year, the presence of annosus root rot was confirmed at a new site. Infected plantations were reported in most counties in the central, western, and southern part of the State.

Armillaria root disease, *Armillaria* spp.

Region 1: Idaho, Montana

Host(s): Douglas-fir, other conifers

Armillaria root disease (*A. ostoyae*) was widely distributed in northern Idaho and western Montana. The apparent increase of this root disease in parts of Region 1 is attributed, in part, to the increase in Douglas-fir and true firs resulting from fire control and selective harvesting of high-value

pine and western larch early in the 20th century. It is also a major cause of mortality in young ponderosa pine (15-25 years old) plantations.

Region 2: Colorado, South Dakota, Wyoming

Host(s): Engelmann spruce, lodgepole pine, ponderosa pine, subalpine fir, white fir

This root disease (*Armillaria* spp.) continues to cause mortality of Black Hills spruce and ponderosa pine on the Black Hills National Forest. Surveys conducted in 1993 indicated that more than 10 percent of the northern and central Black Hills were occupied by disease centers, whereas disease occurrence was negligible in the southern Black Hills. *Armillaria* root disease is the most common root disease in Colorado. It is affecting management of mixed conifer stands on the southern Ute Reservation and is present in the spruce/fir stands at the Truby Complex Timber Sale areas on the San Juan National Forest and near Priest Lake on the Uncompahgre National Forest. The disease is also a major problem in the spruce/fir leave strips at the Aspen Mountain ski area and is killing scattered firs in similar leave strips at the Crested Butte Mountain Resort ski area. Detailed assessments of *Armillaria* root disease impacts were carried out: 1) in lodgepole pine stands on the Alpine Plateau (west of Gunnison) and near Horseshoe Campground and Buckhorn Creek on the Arapaho and Roosevelt National Forests; 2) in mixed conifer stands on the Southern Ute Reservation; 3) in ponderosa pine and white spruce stands in the Black Hills National Forest; and 4) in the spruce/fir leave strips at the Crested Butte ski area (Gunnison National Forest).

Region 3: Arizona, New Mexico

Host(s): Aspen, Douglas-fir, ponderosa pine, spruce, true firs

Root diseases and their associated pests are responsible for about one-third of the conifer mortality Regionwide. *Armillaria* spp. account for about 80 percent of this mortality. A greater percentage of the mixed conifer and spruce-fir forests are infected, compared to ponderosa pine type.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Douglas-fir, grand fir, pines, spruce, subalpine fir

Evidence of *Armillaria* spp. root disease can be found throughout the Region. In southern Idaho, northern Utah, Nevada, and Wyoming, it functioned primarily as a weak pathogen or saprophyte, causing little direct mortality. In southern Utah, it may act as a primary pathogen killing mature and immature ponderosa pine and mature fir and spruce.

Region 5: California

Host(s): Conifers, some hardwoods

Armillaria spp. is widespread in ornamental plantings. It is also damaging in some native oak stands. Incidence and severity of *Armillaria* root disease in 1993 was similar to past years.

Region 6: Oregon, Washington

Host(s): Conifers

The most serious losses from this disease (*Armillaria ostoyae*) occurred east of the Cascade Range in mixed conifer stands. In some stands in eastern Oregon where soils are compacted or displaced, mortality was high and is expected to continue. True firs and Douglas-fir sustain the most losses; however, in localized areas ponderosa pine was seriously damaged. Losses west of the Cascades were usually confined to younger, often stressed trees. Assessing species resistance on a site-by-site basis and encouraging the more resistant species during stand management activities were considered the most effective means of controlling spread and mortality.

Region 9/Northeastern Area: Maine, Michigan

Host(s): Various hardwoods and softwoods

Infection from this opportunistic fungus (*Armillaria* spp.) continued to affect trees of all ages in Maine, particularly balsam fir and spruce, but no new concentrations were found. No significant activity was reported in Michigan.

Black stain root disease

Region 1: Idaho, Montana

Host(s): Douglas-fir, lodgepole pine, ponderosa pine

Black stain root disease (*Ceratocystis wageneri*) was less common than other root pathogens and its importance in Region 1 is largely unknown.

Region 2: Colorado

Host(s): Pinyon pine, ponderosa pine

Black stain root disease (*Leptographium wageneri*) occurs on ponderosa pine in interior portions of Colorado and on pinyon pine in the southwestern corner of the State. The disease is of major concern in recreation areas near McPhee Reservoir and at Mesa Verde National Park.

Region 3: New Mexico

Host(s): Douglas-fir, pinyon pine

Both *Leptographium wageneri* var. *wagneri*, which infects pinyon, and *L. wagneri* var. *pseudotsugae*, which infects Douglas-fir, are rare in the Southwestern Region. The former is confined to two isolated areas in northern New Mexico, and the latter has been observed only in sites in south-central New Mexico.

Region 4: Idaho, Nevada, Utah

Host(s): Pinyon pine

Black stain root disease (*Ophiostoma wageneri*) causes mortality of pinyon pine on the Bureau of Land Management Burley District in Idaho, on the Humboldt and Toiyabe National Forests in Nevada, and on the Dixie and Manti-LaSal National Forests in Utah.

Diseases: Native

Region 5: California

Host(s): Douglas-fir, Jeffrey pine, pinyon pine, ponderosa pine

In northwestern California, black stain root disease (*Leptographium wageneri*) is damaging Douglas-fir plantations and mature trees, extending from the Oregon border to as far south as Santa Cruz County. Thousands of acres of ponderosa pine in northeast California and pinyon and Jeffrey pine in Southern California have infected trees.

Region 6: Oregon, Washington

Host(s): Douglas-fir, ponderosa pine

In southwestern Oregon, black stain root disease (*Ophiostoma wageneri*) was the most commonly encountered disease in Douglas-fir plantations. High risk areas are considered to be those where disturbances such as road building or soil compaction has occurred or where road maintenance equipment injured roadside Douglas-firs. Black stain root disease was observed with increasing frequency on ponderosa pine east of the Cascades. It is an important management concern where stocking level control is planned for poor quality overstocked stands.

Brown root disease, *Phellinus nozious*

Region 5: Northern Marianas Islands

Host(s): Flame tree, other hardwoods

On Saipan and Rota, the fungus is killing prominent trees in naturalized stands and ornamental plantings. Trees of all ages and sizes are dying in scattered centers throughout these islands.

Dwarf mistletoes, *Arceuthobium* spp.

Region 1: Idaho, Montana

Host(s): Douglas-fir, lodgepole pine, ponderosa pine, western larch

Lodgepole pine dwarf mistletoe infected 2 million acres (28 percent) of the lodgepole type in Region 1 and caused about 18 million cubic feet of growth reduction. Dwarf mistletoe is locally heavy in ponderosa pine stands around Lake Coeur d'Alene and along the Spokane River drainage in northern Idaho. Douglas-fir dwarf mistletoe infected .6 million acres (13 percent) of Douglas-fir reducing growth by approximately 13 million cubic feet. Western larch dwarf mistletoe occurred on about .8 million acres (38 percent) of western larch stands, and reduced growth by over 15 million cubic feet.

Region 2: Colorado, Wyoming

Host(s): Lodgepole pine

Lodgepole pine dwarf mistletoe (*A. americanum*) caused the greatest disease losses in Region 2. Losses equal at least 10 million cubic feet an-

nually. In Colorado, 50 percent of the lodgepole pine type is infected. Forest Health Management has funded presuppression surveys on 30,398 acres on five National Forests and silvicultural control on 1,470 acres on five National Forests. Moderate levels of the disease were detected at the Crested Butte Mountain Resort ski area. Vegetation management projects were reviewed in campgrounds on the Gunnison and San Isabel National Forest. In Wyoming, dwarf mistletoe is widespread in some areas of the Bighorn National Forest and Shoshone National Forest.

Limber pine dwarf mistletoe (*A. cyanocarpum*) continued as a minor problem in Colorado. Pinyon pine dwarf mistletoe (*A. divaricatum*) continued as a minor problem in western Colorado. Douglas-fir dwarf mistletoe (*A. douglasii*) occurs mostly in the southern two-thirds of the State. Moderate to high levels of the disease were detected in forests near North Cochetopa Pass. No suppression projects were funded by Forest Pest Management in 1993.

Ponderosa pine losses from southwestern dwarf mistletoe (*A. vaginatum*, subsp. *cryptopodum*) amount to 885,000 cubic feet annually. Suppression projects emphasized tree removal and pruning of infected trees in developed recreation sites. The disease continues to be a factor affecting management on the San Isabel, San Juan, and Uncompahgre National Forests, and on the Southern Ute Reservation in Southern Colorado.

Region 3: Arizona, New Mexico

Host(s): Douglas-fir, pines, spruce, true firs

Dwarf mistletoes (*A.* spp.) are the most widespread disease-causing agents in the Southwestern Region. Approximately 1,040,000 acres of National Forest lands are infected by dwarf mistletoes in Arizona, and 1,140,000 acres are infected in New Mexico. Recent surveys suggest that the incidence of southwestern dwarf mistletoe on ponderosa pine has increased from 30-to 38-percent over the past 30 years. The increase is believed to be the result of human activities such as suppression of wildfires, inappropriate harvesting practices, and lack of priorities for treating infested stands. The other dwarf mistletoes have probably increased and for the same reasons.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Douglas-fir, Jeffrey pine, lodgepole pine, ponderosa pine, true firs, western larch

Suppression projects for dwarf mistletoes (*A.* spp.) continued to remove infected overstory trees; however this forest disease remains the most widespread and frequently observed disease within the Intermountain Region. Regional incidence by major host species is as follows: lodgepole pine = 45 percent infected, ponderosa pine = 25 percent infected, and Douglas-fir = 33 percent infected.

Diseases: Native

Region 5: California

Host(s): Douglas-fir, pines, true fir

Mistletoes (*A.* spp.) infest conifers on about 2.5 million acres of commercial land, contributing to an estimated 100 million cubic feet of wood lost. Dwarf mistletoes' distribution and impacts change slowly from year to year. Dwarf mistletoe was associated with branch flagging in red and white fir throughout the central and southern Sierra Nevada. Drought stress, bark beetles, and cytospora canker were involved in this pest complex.

Region 6: Oregon and Washington

Host(s): Conifers

Dwarf mistletoes (A. spp.) are present on approximately 9.5 million acres of forested lands in the Pacific Northwest Region. Their status changes little from year to year; however, long-term impacts, including reduced growth, mortality, deformity, and topkill, are significant, particularly in unmanaged stands. All conifer species are affected to some degree. Douglas-fir dwarf mistletoe was the most damaging tree disease east of the Cascades. Western larch dwarf mistletoe causes significant effects in northeastern Oregon and central to eastern Washington.

Region 9/Northeastern Area: Maine, New Hampshire, New York

Host(s): Spruce

Severe damage as the result of eastern dwarf mistletoe (*A. **pusillum***) continued in stands of white spruce in coastal areas of Maine. There was mortality and decline amoung landscape value trees. No significant changes were reported in New Hampshire or New York.

Region 10: Alaska

Host(s): Western hemlock

Hemlock dwarf mistletoe (*A. **tsugense***) activity is resulting in reduced radial growth, bole deformities, and tree death of western hemlock on an estimated 3.4 million acres of designated commercial forest land and on a large acreage of noncommercial forest land in southeast Alaska. Dwarf mistletoe is favored by the small-scale disturbance in old, unmanaged stands, where it plays a significant ecological role affecting forest structure, diversity, and wildlife habitat. In managed systems, the abundance of the disease is strongly associated with the distribution, size, and infection intensity of residual trees; thus, specific levels of disease can be achieved by manipulating these variables. Previous harvesting with traditional clearcutting has minimized this disease in managed stands. Movement to other types of harvesting, leaving more residual trees, promises to increase management concerns (and opportunities) for this disease.

Fusiform rust,
Cronartium quercuum* f. sp. *fusiforme

Region 8: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Texas, Virginia

Host(s): Southern pines

Fusiform rust is the most damaging disease of loblolly and slash pines in the South. Other pine species may also be infected, but little mortality or other damage occurs. According to analysis of the most recent forest inventory data, an estimated 13.7 million acres of loblolly and slash pines have infection levels greater than 10 percent: 30 percent of the total host acres. Georgia has the worst disease situation with 4.6 million acres having 10 percent or more infection: 49 percent of the host type. Since the 1992 report, a revised method for selecting plots and analyzing fusiform rust infection has been implemented. As a result, affected acres in this 1993 report cannot be directly compared to previous year's reports. A separate report using the new methodology is being prepared, which will address the change in rust levels over time.

Heart rot,
Basidiomycetes

Region 10: Alaska

Host(s): All tree species

Heart rot causes more economic loss than all other diseases in Alaska. For example, heart rot accounts for most of the estimated one-third cull of live trees in coastal forests and limits the commercial management of hardwoods in interior Alaska. Besides economic effects, heart rot fungi appear to be the primary disturbance agents that drive the canopy-gap process of disturbance in many forests. In Alaska, they greatly alter forest structure and succession, as well as directly enhance wildlife habitat. Specific heart rot levels, including the goal of managing for moderate heart rot amounts, can be achieved in managed stands by controlling the frequency and size of bole wounds during stand entries.

Laminated root rot,
Phellinus weirii

Region 1: Idaho, Montana

Host(s): Douglas-fir, grand fir

Laminated root disease was very severe on parts of the Lolo, Kootenai, and Idaho Panhandle National Forests. It was also found on the Nez Perce National Forest. Damage from laminated root disease has increased in recent years. This is attributed to the loss of root disease-tolerant western white pine to blister rust, and other factors that have increased the abundance of Douglas-fir and grand fir during the present century.

Diseases: Native

Region 6: Oregon, Washington

Host(s): Conifers

Laminated root rot was the most serious forest tree disease west of the Cascade Mountains in Washington and Oregon. Overall, an estimated 8 percent of the area in susceptible species is affected in this portion of the Region. In some locations, survey data indicates that as much as 15-20 percent of the area is affected. East of the Cascades, reports of laminated root rot increased as awareness increased. Effects of the disease include significant changes in species composition, size, and structure. Regeneration of susceptible species in root disease centers may not grow beyond sapling and pole-size. Hardwood trees and shrubs, which are immune to the fungus, often increase their site occupancy. Where stand activities have occurred, managers have favored retention or planting of immune or resistant species to keep mortality and spread within acceptable levels.

Oak wilt, *Ceratocystis fagacearum*

Region 2: Kansas, Nebraska

Host(s): Oak species

The disease continues to slowly spread in the eastern third of Kansas.

Region 8: Arkansas, Kentucky, North Carolina, South Carolina, Tennessee, Texas, Virginia

Hosts: Oaks, mainly red oak group; Live oaks in Texas

Oak wilt continues to be epidemic in Central Texas. New detections increased the number of affected counties to 49. One new detection occurred just outside of Houston. A cooperative oak wilt suppression project continues in Central Texas. In all other States, little new or serious disease activity was reported.

Region 9/Northeastern Area: Indiana, Iowa, Michigan, Minnesota, Missouri, New York, West Virginia, Wisconsin

Host(s): Oaks

There was no significant activity reported in Indiana in 1993. Aerial surveys showed infection of oaks continued on over 10,400 acres in 36 counties of Iowa. In Michigan, extensive mortality from the two-lined chestnut borer hindered detection efforts. Approximately 1,200 infection centers were treated in the metro area of Minnesota, representing 40-percent of the infected area. The counties of Washington, Ramsey, and Dakota reported the disease for the first time in 1993. Sixty-seven trees with oak wilt were reported in Atchison County, Missouri. Four counties in Missouri reported oak wilt for the first time, but reports were unconfirmed. In New York, samples were collected from symptomatic trees, but there was no confirmation of oak wilt. Infection was reported in over 100 trees in West Virginia; no diseased trees were detected in previously uninfected counties. Aerial and ground surveys were conducted in Wisconsin, where oak wilt caused some mortality.

Diseases: Nonnative

Beech bark disease, *Nectria coccinea* var. *faginata*

Region 8: North Carolina, Tennessee

Host(s): American beech

Mortality caused by this disease was found in the Great Smoky Mountains National Park; the southernmost extension of this disease. The affected area is approximately 100 acres within a three-county area: Swain County, North Carolina; Haywood County, North Carolina; and Sevier County, Tennessee.

Region 9/Northeastern Area: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia

Host(s): American beech

Beech bark disease was reported statewide in Maine. Infection was severe on 262,000 acres in New York. Levels in Vermont remained stable and symptoms were less noticeable during aerial survey than they were in 1992. A ground survey in West Virginia delineated the range of the scale insect and reported it on 745,000 acres. Mortality was spotty on about 580,400 acres. No significant activity or change was reported in Connecticut, Massachusetts, New Hampshire, New Jersey, Ohio, Pennsylvania, or Rhode Island.

Dutch elm disease, *Ceratocystis ulmi*

Region 1: Idaho, Montana, North Dakota

Host(s): American elm

Dutch elm disease continued to spread in urban areas in North Dakota and Montana. Montana's highest losses occurred in Billings and Great Falls. In northern Idaho, it has been reported in Moscow, where several infected trees were removed in 1990.

Region 2: Colorado, Kansas

Host(s): Elm species

Incidence of Dutch elm disease was up slightly in 1993. This is the result of freeze damage of October 1991. There was a large increase in trunk attacks due to the 1991 freeze, which increased the number of declining trees in the Colorado Springs area. Two Regal elm positives were collected from the Colorado Springs nursery. Dutch elm disease is still a serious problem in many Kansas urban areas. The 1993 reports of the disease were about the same as in 1992.

Diseases: Nonnative

Region 8: Regionwide

Host(s): Elms

Dutch elm disease was reported in four additional parishes in Louisiana in 1993: Jackson, LaSalle, Sabine, and Caldwell. Louisiana now has a total of 22 parishes known to have Dutch elm disease. This disease was also identified in central Oklahoma. Increased mortality was reported in Tennessee.

Region 9/Northeastern Area: Areawide

Host(s): American elm

Infection of American elm by Dutch elm disease (*Ophiostoma ulmi*, *O. novo-ulmi* = *Ceratocystis ulmi*) continued throughout the Northeastern Area States. High humidity aided proliferation of the disease in Iowa. Mortality continued in New York.

European larch canker, *Lachnellula willkommii*

Region 9/Northeastern Area: Maine

Host(s): Eastern larch

A quarantine continued in Maine, where movement of larch was restricted in Hancock, Knox, Lincoln, Waldo, and Washington counties.

Poplar leaf rust, *Melampsora larici-populina*

Region 6: Oregon and Washington

Host(s): Black cottonwood, cottonwood hybrids

Melampsora larici-populina, native to Eurasia, was found in late autumn 1991 in hybrid poplar plantations along the lower Columbia River in Washington and Oregon. Surveys completed in 1992 and 1993 indicate that the fungus has spread to other poplar plantings; however, incidence and related damage were low. No impacts to coniferous alternate hosts were observed.

White pine blister rust, *Cronartium ribicola*

Region 1: Idaho, Montana

Host(s): Western white pine, whitebark pine

White pine blister rust caused extensive tree mortality throughout the range of western white pine and prevented management of wild-type western white pine on high-hazard sites. Restoration of stands damaged by blister rust and other factors is progressing by planting them with rust-tolerant white pine. Blister rust occurs throughout the range of whitebark

pine, causing severe mortality in localized areas and a reduction in cone production.

Region 2: Wyoming, South Dakota

Host(s): Limber pine

Branch and tree mortality continued at several locations in Wyoming's Bighorn and Shoshone National Forests. The disease is present at a remote stand in the Black Hills of South Dakota.

Region 3: New Mexico

Host(s): Southwestern white pine

White pine blister rust occurs throughout the range of southwestern white pine (*Pinus strobiformis*) in the Sacramento Mountains and adjoining White Mountains of southern New Mexico. Roughly one-half million acres are affected.

Region 4: Idaho

Host(s): Whitebark pine

White pine blister rust occurs infrequently in southern Idaho. High levels of infection in localized areas result in branch, top, and entire tree mortality of hosts.

Region 5: California

Host(s): Sugar pine, western white pine

Blister rust infects white pines throughout the Sierra Nevada and Coast Range and thwarts management of susceptible trees in some areas. Incidence and severity are similar to 1993.

Region 9/Northeastern Area: Maine, New Hampshire, Vermont

Host(s): Eastern white pine

The disease continued to occur statewide in Maine. Efforts to control the disease by destruction of *Ribes* spp. continued on about 5,000 acres of high-value pine stands. No significant activity was reported from New Hampshire or Vermont.

Diseases: Origin unknown

Butternut canker, *Sirococcus clavigigenti juglandacearam*

Region 8: Georgia, North Carolina, Tennessee, Virginia

Host(s): Butternut

The disease has been in Region 8 for at least 40 years and is estimated to have killed 70 percent of the resource in North Carolina and Virginia. The USDA Forest Service has placed a moratorium on the harvesting of healthy butternut trees. In 1991, trees exhibiting resistance were found in North Carolina. These trees are being propagated by grafting and nut collection for host resistance studies. Butternut canker is projected to spread and kill most of the resource, including regeneration. The species will be replaced by other hardwoods on the site. It is too early to project the benefits of resistance selection and breeding.

Region 9/Northeastern Area: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin

Host(s): Butternut

Butternut canker was suspected in Maine, and a 1993 ground survey confirmed its presence in Kennebec, Lincoln, Sagadahoc, and Waldo counties. In New York, samples of butternut were collected and cultured. Infection was confirmed in Schoharie County. In Vermont, the disease was confirmed present and caused mortality in all counties. A survey of 1,394 trees in 32 counties was conducted in Wisconsin in 1993: 91 percent of the live butternut were infected and 27 percent of the trees surveyed were dead.

Dogwood anthracnose, *Discula destructiva*

Region 8: Alabama, Georgia, Kentucky, North Carolina, South Carolina, Tennessee, Virginia

Host(s): Flowering dogwood

Dogwood anthracnose was first noted in the South in 1987 with the report of 30,000 acres affected in the Cohutta Wilderness in northern Georgia. Surveys and impact plots across the 7 affected southern States have now identified 222 counties and 17,289,821 acres impacted by this disease. Dogwood anthracnose is primarily found in the mountains, foothills, and upper Piedmont. Damage is most severe in the forest environment at higher elevations and in cool moist areas in the lower elevations.

Region 9/Northeastern Area: Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia

Host(s): Flowering dogwood

The fungus was confirmed on samples collected from ornamental dogwoods during a survey in York County, Maine. Infection was not found, however, in a small woodland stand thought to be the most northern native stand of flowering dogwood. Mortality of flowering dogwood occurred in New York. In Vermont, a survey in 1993 resulted in confirmation of dogwood anthracnose on naturally occurring dogwood in Bennington and Windham counties. This disease continued to occur with no changes reported in Connecticut, Maryland, Massachusetts, New Hampshire, Ohio, Pennsylvania, Rhode Island, and West Virginia.

Port-Orford-cedar root disease, *Phytophthora lateralis*

Region 5: California

Host(s): Port-Orford-cedar, Pacific yew

This disease remains limited to the Smith River drainage in California (Del Norte County), except for a few trees on the Siskiyou National Forest (Siskiyou County). The infected yew are located adjacent to infected Port-Orford-cedar trees. The Inter-Regional Port-Orford-cedar Program continues to consolidate and inventory measures for spread reduction.

Region 6: Oregon

Host(s): Port-Orford-cedar

Port-Orford-cedar root disease causes mortality of Port-Orford-cedar in southwestern Oregon. Approximately 4,200 acres containing diseased trees were mapped during the annual aerial detection survey. The disease causes extensive mortality on sites favorable for spread of its waterborne spores, especially along creeks, in low lying areas, and below roads where water is channelled. Port-Orford-cedar on well-drained sites usually escapes infection. Preliminary research results suggest that some resistance to the disease exists in Port-Orford-cedar populations.

Other Conditions by Region

Declines and Complexes

Ash decline

Region 9/Northeastern Area: Areawide

Host(s): Brown ash, green ash, white ash

Dieback and mortality of white and green ash continued to occur in the midwestern States, New England, and New York. In some areas, especially in the Midwest and New York, the decline is associated with ash yellows disease. In New England, extreme seed production in 1992 caused late foliation and dieback in crowns. Severe dieback and mortality of brown ash occurred in Maine: a ground survey was conducted, and 38 percent of the plot trees were found to be dead or dying back.

Large aspen tortrix, *Choristoneura conflictana*
Marssonina leaf blight, *Marssonina populi*
Western tent caterpillar, *Malacasoma californicum*

Region 3: Arizona, New Mexico

Host(s): Aspen

Defoliation was detected on 17,220 acres of host type in 1993, compared to 20,550 acres in 1992. Defoliation on Federal lands included 3,560 on the Carson National Forest, 880 acres on the Cibola National Forest, 440 acres on the Gila National Forest, 280 acres on the Lincoln National Forest, 4,800 acres on the Santa Fe National Forest, 20 acres on the Apache-Sitgreaves National Forest, 1,940 acres on the Coconino National Forest, 3,990 acres on the Kaibab National Forest, 10 acres on the Tonto National Forest, 320 acres on the Navajo Indian Reservation, 160 acres on the Santa Clara Indian Reservation, 560 acres on the Taos Pueblo Indian Reservation and 130 acres on the Ft. Apache Indian Reservation. An additional 130 acres of defoliation occurred on State and private land in Arizona.

Oak decline, abiotic and biotic influences

Region 8: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia

Host(s): Oaks and common associates such as hickories

Oak decline is a syndrome resulting in dieback and mortality of dominant and codominant mature oaks. Causal factors are stressors such as drought, frost, defoliation by insects, secondary agents such as *Armillaria* root disease, and the two-lined chestnut borer. Host age and site conditions also play a role. Data analysis of forest inventory data in 12 southern States indicates an estimated 3.9 million acres of upland hardwood forest are affected by oak decline–about 9.9 percent of the vulnerable host type. Average annual mortality volume of oaks on affected sites was 45 percent higher than on unaffected areas. Some of the oak decline reported here is located in areas heavily defoliated by the Gypsy moth (see Gypsy moth entry). Oak decline and gypsy moths interact; pre-existing oak decline increases mortality after gypsy moth defoliation and severe defoliation can induce oak decline in previously asymptomatic areas.

Region 9/Northeastern Area: Iowa, Michigan, New York

Host(s): Oaks

Almost 4,000 acres of oak decline were reported in Iowa, possibly due to drought from 1988-1989. Several factors contributed to decline of northern pin oak in Michigan. These included droughty growing conditions, freeze damage from 1992, gypsy moth defoliation, age, and two-lined chestnut borer damage. Decline occurred across the range of oak in the Lower Peninsula. There was between 10-to 100-percent mortality, and the total area affected was 387,000 acres. In New York, there was concern about decline of black oak on Long Island.

Spruce-fir decline

Region 9/Northeastern Area: Maine, New Hampshire, New York, Vermont, West Virginia

Host(s): Balsam fir, red spruce

Dieback and mortality of red spruce and balsam fir continued in northern New England and New York. Red spruce at the higher elevations in West Virginia also continued to be affected. Major stress factors were various insects and diseases, along with winter injury.

Yellow-cedar decline

Region 10: Alaska

Host(s): Yellow-cedar

Yellow-cedar (*Chamaecyaparis nootkatensis*) has been dying on over 570,000 acres in southeast Alaska. The primary cause appears to be a naturally-occurring abiotic factor. Decline areas have not substantially increased or decreased in the last 100 years; however, effects on those acreages are intensifying and decline of this valuable tree species is expected to continue.

Impacts include reduced subsistence use, diminished timber value, and altered successional patterns. Coupled with harvesting and inadequate natural regeneration, decline is contributing to a reduction of yellow-cedar populations. Recent management efforts have been directed towards artificial regeneration of yellow-cedar.

Seed Orchard Insects and Diseases

Coneworms, *Dioryctria amatella*, *D. clarioralis*, *D. disclusa*, *D. merkeli*

Region 8: Regionwide

Host(s): Southern pines

Late season attacks caused extensive damage to several seed orchards across the South. One orchard in Florida reported losses of nearly 30 percent of the cone crop. Early season damage by *D. disclusa* was minimal across the South, with most orchards reporting losses of less than 5 percent. Longleaf pine continues to suffer heavy damage from coneworms in combination with other insects.

Dioryctria contortella

Region 6: Oregon

Host(s): Douglas-fir grafted seedlings

Large, overwintering larvae of this bivoltine species were found feeding on the bark of 1- and 2-year-old graft unions. Less than 10 percent of the grafts were infested. In some instances, the grafts were completely girdled by the feeding.

Fir cone worm, *Dioryctria abietivorella* Lodgepole pine cone moth, *Eucosmsa rescissoriana* Western conifer seed bug, *Leptoglossus occidentalis*

Region 1: Idaho, Montana

Host(s): Conifers

Cone and seed insects are becoming of increased significance in Region 1 because of the high value of the blister rust resistant western white pine seed being produced, and because several orchards of other tree species are reaching cone-bearing age. The primary insect pests of concern are the western conifer seed bug, *Leptoglossus occidentalis*, the lodgepole pine cone moth, *Eucosma rescissoriana*, and the fir cone worm, *Dioryctria abietivorella*. The western conifer seed bug was abundant throughout northern Idaho in 1993. It was potentially damaging enough at the Coeur d'Alene white pine seed orchard to require insecticidal spraying. Also, spraying was required at the Moscow, Idaho, seed orchard to control seed bugs, cone worms, and cone moths.

Seedbugs,
***Leptoglossus corculus*,**
Tetyra bipunctata

Region 8: Regionwide

Host(s): Southern pines

Seedbug populations on slash and loblolly pines caused extensive damage in several States. South Carolina reported-20 percent damage in a seed orchard in Jasper County. Seedbug damage to longleaf pines was severe. In addition to damaged and empty seed, early season cone abortion was extensive. The 1993 cone crop for north Alabama longleaf on the Erambert Seed Orchard suffered a 60-percent loss before July. Seedbugs and coneworms are thought to be responsible for a significant amount of this loss.

Nursery Insects and Diseases

A Mindarus twig aphid, *Mindarus* sp.

Region 5: Northern California

Host(s): White fir

An Itegrated Pest Management (IPM) program based on recent research is in place at the Placerville nursery. It now appears that the aphid is a new species. The damage to 1-0 seedlings was previously reported as caused by the balsam twig aphid, *Mindarus abietinus*.

Botrytis cinerea *Cylindrocarpon* spp. *Fusarium* spp. *Pythium* spp.

Region 1: Idaho, Montana

Host(s): Conifers

The most common and damaging diseases of conifer seedlings in nurseries in Region 1 are root diseases caused by *Fusarium* spp. These fungi cause damping-off and root diseases on many different conifer hosts in bareroot and container nurseries. The most common soil-borne pathogen specie in bareroot nurseries is *F. oxysporum*, although several other species are commonly isolated from infested soil and diseased seedlings. The major pathogen in container nurseries is *F. proliferatum*, although *F. oxysporum* and several other fusaria may occur at high levels in some nurseries. Although all conifer species are susceptible, most damage occurs on Douglas-fir, western larch, western white pine, and Engelmann spruce. *F. acuminatum* occurred at very high levels on whitebark pine seed, especially on selected lots from the Gallatin National Forest. This fungus may adversely affect seed germination and contribute to reduced seedling establishment.

Botrytis cinerea was more prevalent in 1993 than in recent years on nursery seedlings at several locations. It also caused damage to large plantation trees at several sites in northern Idaho. This faculative parasite colonized necrotic tissues killed by other agents. It caused unusually high levels of damage to container-grown western red cedar seedlings at the Forest Service Nursery in Coeur d'Alene. Stock was especially damaged after being in cold storage during the winter.

Cylindrocarpon spp. (especially *C. destructans*) continued to cause unacceptable losses to western white pine and whitebark pine seedlings. Damage to other conifer species also occurs, but root decay of five-needle pines is most serious. Tip dieback caused by *Sirococcus strobilinus*, *Sphaeropsis sapinea*, and *Phoma eupyrena* occurred at several nurseries on bareroot pine seedlings. Ponderosa pine and lodgepole pine were the most commonly affected species.

Pythium root disease (mostly *P. ultimum*) occurs at some level at most bareroot nurseries but can also be found in container seedlings. Damage is usually minor and can be mitigated by improving water drainage in soil and container media.

Damping-off, *Fusarium* spp., *Pythium* spp.

Region 6: Oregon, Washington

Host(s): Conifers

At the three regional nurseries, lots sown at the usual time (April or May) suffered only average losses to damping-off: approximately 1 percent. At one nursery, lots sown early (March) exhibited virtually no damping-off.

Region 6: Oregon

Host(s): Bitterbrush

At one nursery, a heavy thunderstorm resulted in flooding of the field of 1-0 bitterbrush for several hours in June. Resulting foliar dieback stressed seedlings, making them susceptible to root rot caused by *Fusarium*. Of 1.2 million seedlings, only 500,000 (42 percent) survived. At another nursery, 2 weeks of overwatering resulted in foliar dieback and 5-percent mortality in three lots of 1-0 bitterbrush. At both nurseries, most bitterbrush seedlings reflushed, but this was difficult for such small seedlings.

Region 6: Oregon

Host(s): Douglas-fir

At one nursery, 25 percent of the root systems of two lots of 1+1 Douglas-fir were destroyed by *Pythium* while in cold storage.

Fusarium cortical stem rot, *Fusarium avenaceum*

Region 4: Idaho, Utah

Host(s): Douglas-fir, ponderosa pine, true firs

This disease caused scattered mortality, primarily of 1-0 conifer seedlings, at the Lucky Peak Nursery, Boise National Forest, Idaho, and the Lone Peak Nursery in Utah.

Fusarium root disease, *Fusarium oxysporum*

Region 4: Idaho, Utah

Host(s): Douglas-fir, ponderosa pine, true firs

This disease caused small amounts of mortality, primarily of 1-0 conifer seedlings, at the Lucky Peak Nursery, Boise National Forest, Idaho, and the Lone Peak Nursery in Utah.

Fusarium root and hypocotyl rot, *Fusarium* spp.

Region 6: Oregon

Host(s): Conifers

At one nursery, two fields of ponderosa pine suffered only scattered losses, partly mitigated by the cool wet weather. The July fertilization seemed to stimulate an increase in *Fusarium* mortality. At another nursery, total losses were limited to a 30-percent loss of one seed lot of Douglas-fir to *Fusarium* root rot, associated with late sowing (June).

Fusarium spp.

Region 5: California

Host(s): Douglas-fir, sugar pine, true firs, others

Fusarium continues to be the most damaging seedling disease in the State. Damping-off, chlorosis, stunting, and hypocotyl rot were associated with the pathogen.

Gray Mold, *Botrytis cinerea*

Region 6: Oregon, Washington

Host(s): Conifers

At one nursery, up to 10-percent cull is expected in 2-0 Douglas-fir due to delay in treatment. Because Benomyl was temporarily unavailable, the nursery could only use chlorothalonil, and *Botrytis* builds resistance quickly. Implementation of the use of Botran authorized in the signing of the Supplemental Environmental Impact Statement (EIS) was delayed until the end of August because of the required waiting period. At another nursery, losses were kept to a minimum (less than 1 percent) by maintaining seedbed densities near 20 per square foot, removal of pruned material (after top pruning), and one application of Benlate and Botran in a tank mix.

Phytophthora root rot, *Phytophthora* spp.

Region 6: Oregon, Washington

Host(s): Conifers

At one nursery, 1+1 larch seedlings had a high incidence of *Phytophthora* root disease. One-third of two seedbeds was lost to root rot. Losses were associated with higher than normal rainfall, heavy/poorly drained soils, and root wrenching stress. At another nursery, the weather was cool, but dry; resulting in little detectable *Phytophthora*.

Phytophthora/Pythium root rot, *Phytophthora spp.*, *Pythium spp.*

Region 4: Idaho, Utah

Host(s): Douglas-fir, spruce

These fungi occured on seedlings and in soil at the Lucky Peak Nursery, Boise National Forest, Idaho, and the Lone Peak Nursery in Utah. Infection resulted in frequent mortality and culling of 2-0 seedlings.

Pitch canker, *Fusarium subglutinans*

Region 8: North Carolina, Tennessee

Host(s): Longleaf pine, shortleaf pine, slash pine, Virginia pine

Pitch canker was first identified as a tree pathogen on Virginia, shortleaf, and pitch pine in 1946. Since then *Fusarium subglutinans* has been found to infect vegetative and reproductive structures. The pitch canker pathogen was proven to cause cone mortality and deterioration of seed in slash, Virginia, shortleaf, and longleaf pine orchards. Pitch canker has also been reported to cause damping-off of southern pine seedlings, and to cause seedling related mortality in first year pine seedlings. This fungus has proven to be a problem in shortleaf seedlings from mountain source orchard seed in Edwards State Nursery in North Carolina.

Poplar and Willow Borer, *Cryptorhynchus rapathi*

Region 6: Oregon

Host(s): Willow

Willow stool beds at the J. Herbert Stone Nursery are infested by this borer. Current infestation is sparce, but contingencies are ready if the damage level increases in 1994.

Rhizoctonia needle blight, *Rhizoctonia* spp.

Region 8: Mississippi, South Carolina

Host(s): Longleaf pine

Rhizoctonia needle blight caused the loss of 250,000 seedlings in one South Carolina nursery. Approximately 15,000 containerized longleaf seedlings were lost at Ashe Nursery in Mississippi.

Shothole Disease, *Coccomyces* sp.

Region 6: Oregon

Host(s): Chokecherry

Shothole disease became evident late in the season at one nursery; losses were less than 1 percent.

Whitefringed beetles, *Graphognathus* spp.

Region 8: Florida, Georgia, South Carolina

Host(s): Loblolly pine, slash pine

Damage contributed to a 300-acre slash pine bedded planting failure in Florida.

Abiotic Damage

Chemical Damage

Region 2: Colorado, Kansas, Nebraska, South Dakota, Wyoming

Host(s): Many hardwood species

Herbicide damage to windbreaks and other tree plantings continue to be a serious problem.

Drought Effects

Region 4: Regionwide

Host(s): All vegetation

Premature needle drop, leaf scorch, and seedling mortality were observed due to 6 consecutive years of below-normal precipitation. Damage was especially apparent on the Toiyabe National Forest in Nevada, which is suffering its seventh year of drought conditions.

Region 5: California

Host(s): Conifers, some hardwoods

Drought-induced white-fir mortality was exceptionally widespread on mixed-conifer sites in northeastern California. Sugar pine, redwood, oaks, manzanita, and other species are also dying prematurely due to lack of moisture. Adequate rains returned to most areas in 1993, and mortality is expected to decrease in 1994.

Region 9/Northeastern Area: Maine, Michigan

Host(s): White birch

In Maine, very dry conditions caused the casting of leaves from many landscape trees. Michigan reported that decline of birch stands affected by drought in the Upper Peninsula had stabilized.

Flooding

Region 8: Florida

Host(s): Cabbage plams, red cedar, other trees

An unusual amount of tree mortality occurred on 87,000 acres of coastal area on the gulf side of Florida. The cause is unknown but the problem may be caused by a rise in the ocean level and salt water.

Region 9/Northeastern Area: Iowa

Host(s): Conifers, linden, maple, oaks

About 98,000 acres of bottomland hardwood areas were severely flooded for 4-12 weeks in Iowa as a result of heavy rainfall. Flood waters backed into upland areas and caused damage to 2,500 acres.

Ozone Injury

Region 5: California

Host(s): Jeffrey pine, ponderosa pine

Reversing a 7-year trend, ozone-injury to pines in the southern Sierra Nevada rose in 1993. Increased precipitation made photosynthetic activity greater, thereby increasing ozone exposure. Fifteen of 25 ozone monitoring plots showed more chlorotic-mottle injury.

Region 8: Regionwide

Host(s): Eastern white pine, various bioindicator species

Tipburn was observed in several eastern white pine families. Indicator plants were used to assess ozone levels in wilderness areas. Symptoms were found throughout the South. The Class I Wildernesses are surveyed on an annual basis and results are compiled and displayed in tabular format with interpretation as Field Office reports. The reports are used by Air Resource Specialists as tools in permit evaluation.

Region 9/Northeastern Area: Maine

Host(s): Black cherry, eastern white pine, white ash

Symptoms of ozone damage were reported in some locations in Maine.

Spring Frost

Region 4: Idaho

Host(s): Western larch

An early spring frost killed foliage on the Payette National Forest, Idaho.

Wind Damage

Region 4: Utah

Host(s): Lodgepole pine, spruce

Approximately 1,000 acres of Englemann spruce and lodgepole pine were blown down by a late summer tornado on the Vernal and Roosevelt Ranger Districts of the Ashley National Forest. The tornado is not expected to cause outbreaks of either spruce beetle or mountain pine beetle. Englemann spruce beetle may be of some concern. Some salvage activities may occur at the White Rocks area on the Vernal Ranger District.

Abiotic Damage

Region 5: Guam

Host(s): Eucalyptus, palms, others

Fierce winds uprooted, defoliated, and broke tops out of plantation and native trees on Guam. The debris increases the hazard posed by fire, flood, weeds, and insects.

Region 8: Florida, Georgia, Tennessee, Virginia

Hosts: All species

Tornadoes and storms caused swathes of damage several miles in length across these four States.

Region 9/Northeastern Area: Maine

Hosts: Evergreens

Minor wind damage to many evergreen trees and shrubs was reported in Maine.

Winter Injury

Region 3: Arizona

Host(s): Ponderosa pine

Winter injury was observed in groups of ponderosa pine trees, ranging from 1 acre up to several hundred acres in size, in forests in northern Arizona. In early spring, discoloration of needles occurred throughout the crown of affected trees. As spring progressed, the older needles fell off, leaving only current-year needles on living branches. Approximately 5,000 acres were affected, with most of the injury occuring on the Coconino National Forest (4,600 acres), compared to the Kaibab National Forest (315 acres) and White Mountain Apache Indian Reservation (110 acres).

Region 3: Arizona

Host(s): Douglas-fir, spruce

Snow and ice damage was observed on approximately 945 acres of spruce-fir forest type on Mt. Graham, Safford Ranger District, Coronado National Forest. The most severe damage occured on about 20 acres of Heliograph Peak, where 90 percent of the trees were severely damaged (especially bole breakage). Since a significant amount of large slash material was generated, insect outbreaks caused by spruce beetle, Douglas-fir beetle, or *Ips* beetles are anticipated if the slash is not treated. Forest Pest Management is helping the District monitor insect populations.

Region 5: California

Host(s): Conifers, hardwoods

Heavy, wet snow and strong winds snapped tops and toppled trees throughout northwestern California. Damage due to cold temperatures was limited to small pockets in 1993.

Region 8: Regionwide

Host(s): All species; predominately pine and cedar

A late winter snow storm (March 1993) caused significant damage to trees and forest stands across the South. Top and limb breakage and uprooted trees were the predominant damage. The most significant damage was reported along roadsides and in urban areas.

Region 9/Northeastern Area: New York

Host(s): Scotch pine

Scotch pine plantations were damaged by heavy snow in New York.

Region 9/Northeastern Area: Maine, Massachusetts, New Hampshire, New York, Vermont

Host(s): Red spruce

In the early spring, several thousand acres of browning of red spruce was reported in northern New England and New York. The most recent year's foliage was damaged by winter injury. The damage was most severe at higher elevations, but low elevation stands were also affected. Damage in Massachusetts affected about 1,500 acres.